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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 123
DECEMBER, 1921

TRANSACTIONS OF THE SECOND ANNUAL CONFERENCE OF STATE SANITARY ENGINEERS

HELD AT BOSTON, MASS.
JUNE 1, 2, 1921

PREPARED BY DIRECTION OF THE SURGEON GENERAL

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STANDING COMMITTEES.

WATER SUPPLY.

W. H. Dittoe, *Chairman.*

C. A. Emerson, jr.
Ralph Hilscher.
A. H. Jewell.
Robert B. Morse.

SEWAGE DISPOSAL AND STREAM POLLUTION.

E. H. Ehlers, *Chairman.*

H. F. Ferguson.
G. H. Hazlehurst.
H. E. Miller.
E. S. Tisdale.

MILK SUPPLY.

C. A. Emerson, Jr., *Chairman.*

C. M. Baker.
J. C. Diggs.
H. Gray.
E. D. Rich.

LAWS, ORGANIZATION, POLICY, AND PROCEDURE.

H. A. Whittaker, *Chairman.*

E. L. Filby.
J. H. O'Neill.
E. D. Rich.

MOSQUITO CONTROL.

R. Messer, *Chairman.*

H. P. Croft.
C. N. Harrub.
F. W. Simons, jr.
H. C. Woodfall.

SWIMMING POOLS.

Stephen de M. Gage, *Chairman.*

Ralph Hilscher.
G. W. Simons, jr.

PROVISIONAL PROGRAM.

WEDNESDAY, JUNE 1.

MORNING SESSION, 10 A. M.

Roll call of States.

Report of executive committee—H. A. Whittaker, chairman; S. Pincus, C. A. Emerson, jr., G. W. Simons, jr., M. Z. Bair.

Report of secretary—M. Z. Bair.

Report of corresponding secretary—I. W. Mendelsohn.

"Some productive activities of a State sanitary engineering office—Robert B. Morse, chief engineer, Maryland State Board of Health.

Report of committee on water supply—W. H. Dittoe, chairman.

AFTERNOON SESSION, 2 P. M.

Address: "State sanitation"—George C. Whipple, professor of sanitary engineering, Harvard University.

Report of committee on cross connections and by-passes on water supplies—S. Pincus, chairman.

The certification and supervision of water supplies on interstate carriers:

"Water-borne epidemics among passengers and crews of vessels"—J. I. Connolly, assistant sanitary engineer, United States Public Health Service.

"The policy of the Public Health Service for the supervision of water supplies of common carriers"—I. W. Mendelsohn, assistant sanitary engineer, United States Public Health Service.

"Experiences with the supervision of water supplies on vessels plying on the Great Lakes"—A. E. Gorman, assistant sanitary engineer, United States Public Health Service.

"The cooperation of the State health departments in the certification of interstate water supplies"—E. S. Tisdale, sanitary engineer, West Virginia State Board of Health.

Report of committee on laws, organization, policy, and procedure—H. A. Whittaker, chairman.

THURSDAY, JUNE 2.

Morning Session, 9 a. m.

Report of committee on milk supply—C. A. Emerson, jr., chairman.

"Supervision of milk pasteurization in Minnesota"—H. A. Whittaker, director, division of sanitation, Minnesota State Board of Health.

Report of committee on stream pollution and sewage disposal—E. H. Ehlers, chairman.

"State control of stream pollution and sewage disposal in Connecticut"—J. F. Jackson, director, bureau of engineering, Connecticut State Department of Health.

Report of committee on mosquito control—R. Messer, chairman.

"Mosquito control work in Arkansas"—M. Z. Bair, sanitary engineer, Arkansas State Board of Health.

Afternoon Session.

Report of committee on swimming pools—Stephen DeM. Gage, chairman.

"Ratproofing from an engineer's point of view"—A. F. Allen, associate sanitary engineer, United States Public Health Service.

Election of officers.

SECOND ANNUAL CONFERENCE OF STATE SANITARY ENGINEERS.

TRANSACTIONS.

Morning Session, Wednesday, June 1, 1921.

The Second Annual Conference of State Sanitary Engineers was called to order at 10 o'clock a. m., June 1, 1921, at the State House, Boston, Mass., Mr. Whittaker presiding.

The following persons were present during the conference:

Representatives of the State health departments:
Connecticut-----Mr. J. Frederick Jackson, director, sanitary engineering.
Georgia---------Mr. H. C. Woodfall, director, division of sanitary engineering.
Indiana---------Mr. John C. Diggs, State sanitary engineer, water and sewage laboratory.
Kansas---------Prof. Albert Jewell, chief, division of water and sewage.
Massachusetts---Mr. Wright, sanitary engineer.
Michigan--------Mr. E. D. Rich, State sanitary engineer.
Minnesota-------Mr. H. A. Whittaker, director, division of sanitation.
Mississippi------Mr. H. A. Kroeze, State sanitary engineer.
Missouri--------Mr. Joel I. Connolly, State sanitary engineer.
New Hampshire--Mr. Charles D. Howard, chemist in charge of water supplies.
New Jersey-----Mr. H. P. Croft, chief, bureau of engineering.
New York-------Mr. Theodore Horton, director, division of sanitary engineering.
North Carolina--Mr. H. E. Miller, director, bureau of engineering and inspection.
Ohio-----------Mr. W. H. Dittoe, chief engineer, division of sanitary engineering.
Pennsylvania----Mr. C. A. Emerson, chief engineer, division of engineering.
Rhode Island----Mr. Stephen DeM. Gage, chemist and sanitary engineer.

Representatives of the State health departments—Continued.

South Carolina--Mr. E. L. Filby, State sanitary engineer.
Tennessee--------Mr. C. N. Harrub, State sanitary engineer.
Virginia---------Mr. E. H. Gage, sanitary engineer.
Washington------Mr. C. E. Dorisy, State sanitary engineer.
West Virginia---Mr. Ellis S. Tisdale, director, division of sanitary engineering.

Representatives of United States Public Health Service:

Associate Sanitary Engineers C. N. Harrub, Sol. Pincus, and A. F. Allen.
Assistant Sanitary Engineers A. E. Gorman, Joel I. Connolly, and I. W. Mendelsohn.
Junior Assistant Sanitary Engineer E. C. Sullivan.

Guests:

Mr. George C. Whipple, professor of sanitary engineering, Harvard University.
Mr. H. W. Clark, director and chief chemist, division of water and sewage laboratory, State Department of Health, Massachusetts.
Mr. Bertram Brewer, assistant engineer, Massachusetts Department of Health.
Mr. Arthur D. Weston, assistant engineer, Massachusetts Department of Health.
Mr. Melvin C. Whipple, instructor, Harvard University.
Mr. M. P. Horwood, instructor, Massachusetts Institute of Technology.
Dr. L. Williams, United States Public Health Service.
Mr. Hearne, assistant sanitary engineer, State Department of Health, Michigan.
Mr. R. S. Weston.
Mr. M. N. Baker.
Mr. William J. Orchard.
Mr. Pratt.
Mr. Leslie H. Allen.

In view of the absence of the regular secretary, Mr. Mendelsohn was appointed secretary of the meeting of the conference at Boston.

The report of the executive committee was made and approved.

A motion was made, seconded, and carried to appoint a committee to reconsider and modify the proposed draft of the constitution of the conference. The committee consisted of Mr. Horton, chairman, Mr. Dittoe, Mr. Tisdale, Mr. Filby, and Mr. Harrub.

REPORT OF CORRESPONDING SECRETARY OF THE CONFERENCE OF STATE SANITARY ENGINEERS FOR THE YEAR ENDING JUNE 1, 1921.

At the Conference of State Sanitary Engineers held in Washington on May 23 and 24, 1920, request was made of Assistant Surgeon General A. J. McLaughlin by the officers of the conference that the Public Health Service sanitary engineer stationed at the bureau be detailed as corresponding secretary of the Conference of State Sanitary Engineers to collect, analyze, and report to all State sanitary engineering divisions data on the prevailing and proposed activities in sanitary engineering. Such an arrangement was agreed to by Dr. McLaughlin, but the statement was made by him that such work as might be accomplished by this sanitary engineer in such capacity was entirely in behalf of the conference and had no connection officially with the bureau.

Associate Sanitary Engineer Pincus became the first corresponding secretary and acted as such until September 1, 1920, when, upon his being detailed elsewhere, Assistant Sanitary Engineer Mendelsohn, who was stationed at the bureau, became corresponding secretary.

Following the desires of the conference, as expressed at the 1920 meeting, efforts were made to transmit information of the work done by each State sanitary engineering division to all the others. Later, upon investigation of the literature on sanitary engineering available to the State sanitary engineers, and, in view of the finding that but few technical journals are used by the State sanitary engineers, it was decided to cull the technical journals of this country, Canada, England, and other nations and transmit abstracts on important articles on sanitary engineering to all the State sanitary engineers. One of the important results of this investigation was that no technical journal of this country covered the sanitary engineering literature of the world as adequately as the matter required, and that valuable foreign contributions on malaria, water treatment, sewage disposal, and other sanitary engineering subjects were not being brought to the attention of the sanitary engineers of this country. It is now endeavored to correct this condition by furnishing weekly public health engineering abstracts, primarily for the use of the State sanitary engineers. It might be added that these abstracts have fulfilled their purpose in several instances already, notably concerning present procedure in malaria measures in the United States and regarding alum treatment of water.

Since October 30, 1920, 1,278 copies of 28 separate bulletins, issued either by State sanitary engineering divisions or other bodies or persons, but all concerning sanitary engineering, have been forwarded through the corresponding secretary to all the State and Government sanitary engineers; and abstracts of over 200 articles on sanitary engineering from the journals of 69 separate technical publications have been mimeographed and sent to the sanitary engineers. Besides these technical publications, many reports of interest to sanitary engineers are available from other nations. The mailing list for the public health engineering abstracts has increased from 82 names on January 1, 1921, to 168 on May 28, 1921, simply as a result of compliance with requests of sanitary engineers for copies.

Other work accomplished included the mimeographing and transmission of questionnaires, forwarding replies for the conference's committees, and assistance with the program for this conference.

It is believed that if a little time is regularly devoted by each State sanitary engineer to forwarding to the corresponding secretary information concerning sanitary engineering matters of interest to the other sanitary engineers, for instance, such as an interesting experiment observed by the sanitary engineer, the sum total of benefits to each sanitary engineer will be large indeed.

Mr. Robert B. Morse, chief engineer, Maryland State Department of Health, presented the following paper:

SOME PRODUCTIVE ACTIVITIES OF A STATE SANITARY ENGINEERING OFFICE.

The measure of the effectiveness of any activity of a State bureau of sanitary engineering may be evolved from a consideration of the probable effect of such an activity upon sickness and death rates from individual or general diseases. As a corrollary to this statement it may be assumed that that activity is most effective which influences the public health to the greatest degree and at the least cost. It naturally follows that, with activities of equal inherent sanitary importance, that which influences the greatest number of people is the most effective. It is true that local conditions and prejudices are modifying influences, but in general the above principles may serve as satisfactory guides for engineering activities.

With this basis of satisfactory performance in mind, it is interesting to note certain variations of procedure of State engineering organizations in apportioning activity and funds. When the engineer finds himself in the position of determining the direction his future or present activities should take, he sometimes seems to have no definite plan of procedure or process of elimination by which he arrives at a conclusion. If one surveys the field of State engineering activity, it is not at all rare to find unbalanced distributions of energy in such fields as comfort station control, swimming pool sanitation, ventilation control, and other functions whose public health implication either is perhaps decidedly hazy or does not affect a large proportion of the public. Engineering bureaus whose force and budget are so large as to permit them to run the gamut of all popular and ephemeral campaigns are rare. Where they exist it may be wise to extend activities to such fields as may be open for the development of esthetic standards, even where the public health advantages therein are only slight. Unfortunately, however, most State organizations are not in the above class, with reference either to funds or to men. They must, therefore, justify the allocation of a large part of their appropriation to a very small proportion of the population, if they carry on such campaigns. Without such a justification it would certainly appear that energies devoted to comfort stations or ventilation, for example, by a small and inadequately financed bureau are misdirected, to say the least. This conclusion, no doubt, will arouse opposition, but should it not stand until the greater relative sanitary importance of comfort station and ventilation activity, as against, for example, that of adequate water-supply control, has been amply demonstrated? In so doing the requirements of public comfort should not be confused with those of the public health.

In similar fashion, we may well ask how much time and money should be expended on such activities as sanitary privy campaigns and railroad and steamboat water supply certification. While the public health importance of these examples is more apparent, the factors of cost and proportion of public affected play a predominating part.

If but a fraction of the time and money that are expended in some sections in an effort to have sanitary privies installed in thinly populated rural districts, or in ill-considered campaigns to have them used throughout villages and towns where complete sewerage systems could be constructed and operated at little, if any, greater individual expense, how much greater would the total sanitary value be. How many more people would be benefited by the construction of a few adequate sewerage systems than by the installation of many sanitary privies. If, also, as much time were given to original investigations in the field of design and operation of water purification works as to consideration of relative values of pet types of sanitary privy, how much broader would be the public health benefit.

The above brief analysis of engineering activity and its public health evaluation seems necessary as an introduction to a discussion of some productive activities of State bureaus. It is not the intention to enumerate all of such activities, but to outline only two forms thereof which have demonstrated their usefulness in Maryland.

The functions of a State bureau of sanitary engineering are those of regulation, development, and investigation. In this paper it is assumed that the powers of supervision over plans exist, for without these it is usually difficult to carry out any effective program of work. We further assume that those who are charged with the approval of plans are of sufficient engineering competency and experience to be able to perform this duty successfully. With incompetent and inexperienced regulatory examination of plans, or with only casual inspection, as is apt to result from unfamiliarity with the problem, this feature of State control will be a failure. We may pass, therefore, to a consideration of the functions of development and of investigation.

The development work in Maryland has for its purpose the installation and extension of public water supply and sewerage systems. This activity is considered of sufficient importance to be provided for as a major division of the bureau. This division has an educational object in the large sense. It aims to promote, for individual towns or combinations of communities, the use of adequate water and sewer systems. It accomplishes this result by a variety of methods, which include the preparation of preliminary plans, of cost estimates, of methods of financing, and the presentation of these and other pertinent data to the communities concerned. The preparation of prelimiary plans was found essential in order to be able to present an intelligent case to the people, to picture to them the location of lines, to demonstrate practicability, and to prepare a fairly accurate cost estimate. By performing the above function, the bureau aids the popular mind in visualizing the concrete system. It becomes easier then to have the town engage the private engineer to prepare complete plans and to obtain necessary bond issues. By stimulating in the above manner the installation of systems in many towns that would not otherwise act, the State aids rather than retards private engineering activity. At the same time information is obtained which permits of a more intelligent survey of the plans later filed by the outside engineer.

With preliminary plans at hand the problem of arriving at a fair estimate of the cost of the improvement to the community is simplified. The importance of this second step in development work can not be too strongly emphasized, since the factor of cost is usually the one which most influences local action. Often the public health argument has but little weight, while low capital and maintenance cost may carry the day. Abstract argument as to the desirability of adequate water and sewerage systems seems to have little influence at least upon Maryland local authorities. Financial rather than health factors almost always control.

Since the mind of the public is apparently considerably more impressed by a dollar than by a death, it becomes necessary for the State to adjust its talking points accordingly. This psychology can not be ignored and, because of it, considerable thought has been given to the development of practicable and just methods of financing water and sewerage systems. Here again human nature predetermines and directs the line of action necessary. It has been made clear to us in most campaigns that the individual rarely is concerned with community welfare. Now and then, a Utopian figure appears whose interests are communal, but most often the individual is interested in the cost to himself. On this account an effort is made to work out for each property holder in the smallest communities, and for standard units of property in larger places, the total annual cost which will result from the introduction of a new system. This can be done when there are available preliminary plans, detailed cost estimates, and information concerning the character, size, and value of individual properties.

It may be of interest to point out that more effective results are obtained by quoting fire insurance rates before and after installation of a water system, than by mere reference in general terms to public health benefits. By the same process of appealing to the individual's pocketbook instead of to his heart, it is usually wise to keep the total cost of a project in the background, while emphasizing the low annual cost to individual property holders.

The plan of financing advocated for both water and sewerage systems need not be gone into in detail here. Its general principles are as follows:

Public and private benefits are separately considered. The payments of fixed and operating charges are kept distinct. The annual cost of the bond issue for constructing both systems is met by a combination of property tax, annual front-foot assessment, and house connection charges; the cost of maintenance of both, by meter service and water consumption rates. These various charges are distributed in such manner that the expense falling upon any individual, public or private, is as nearly as possible proportionate to the benefits which he derives.

It has no doubt already been made evident that the program of development here outlined is a conscious one and is the result of previous planning. It is not intermittent, but continuous and selective. Towns for intensive attention are carefully chosen on the basis of population, sanitary needs, and financial status. Close study of each case from various viewpoints is carried out. The process of development is a deliberate one in which field and office studies and public presentation and discussion alternate and mingle. By devoting a separate division's activities to such work, assurance is had that the campaigns are well thought out and successive and, in this manner, discontinuous, haphazard excursions with general facts are avoided. Special knowledge of each local problem is acquired before and during each campaign. The method of attack in this way acquires at least a scientific aspect and the work should bring fruitful results.

Another phase of State engineering activity which is often ignored, but which has proven its usefulness in Maryland, is that represented under the general head of investigations of special character. The term "research" is here avoided, because of its restricted connotation. Research too often is thought of as conducted in the laboratory on a basis too academic to be practical. Special investigation, however, as a part of the bureau's function, has a much wider application. It has no restrictions made by official division or by impracticability. As we consider it, special investigation is concerned with problems of design, construction, and operation, and with questions of administration. It should include laboratory, office, and field observations. It is necessarily broad, since the State should act as the principal reservoir of information regarding sanitary engineering facts. If it is to serve as this source it must collect data, carry out experiments, develop new methods, interpret existing phenomena, and suggest new principles. This composite function can not be successfully sandwiched in amongst other duties; it demands concentrated and continuous application. As in development work, this activity also requires a special viewpoint and a new body of facts, usually different from those gathered either in administrative or development work.

The justification for the expenditure of time and money for this general class of investigative effort is of several kinds. In the first place no other body exists for the proper development of such data, for their coordination, or for their interpretation. Communities desiring advice turn to the State bureau. It should have available at all times the most complete and recent information upon any sanitary engineering problem in order to carry on its other work competently. In addition, such information must be selected and accurate. The establishment of such a clearing house demands specialization.

Besides the clearing-house function, which investigation supports, special studies also provide for economy of design and operation. They introduce new concepts and procedures which aim at all times to decrease costs and to increase efficiency. Their public-health value is easily measurable if one stops to consider that a new fact learned or an old theory modified may mean the construction of a water-treatment plant and the consequent change from an inferior supply to one of good quality. If investigation should lead to the reduction in cost of any sanitary engineering structure it has aided sanitation by more than the equivalent saving in dollars.

In any discussion of special investigations, we are naturally brought to a consideration of the part so-called "pure research" should play in State sanitary engineering duties. It should hardly be necessary to point out the absence of any transition point from pure to applied research. The two are usually closely allied and it is useless to speak of restricting oneself to either the one or the other. A certain appreciable amount of theoretical scientific study is required in every problem. There is little danger of converting the average State bureau into a cloistered student's chamber, when the demand for the solution of practical sanitary engineering problems is as pressing as it now is. In order to solve some of these, however, a definite scientific method is essential. Without facilities for such special studies, the organization is frequently seriously handicapped.

In the preceding pages an attempt has been made to outline two functions of State sanitary engineering service which are sometimes understressed. The creation of two separate divisions, development and investigation, on a parity with those of field and office, has its origin in the desire to round out the functions of the Maryland bureau. For the most part field and office activities, in the usual sense, are concerned with the natural progress of events; they carry on the current or routine duties. In order to make such duties more effective and broader it is necessary to develop new facts and new systems. Both office and field divisions are already engaged in a definite class of work. The requirements of progress demand additional specialized functions. It is these which the divisions of development and investigation perform. It is believed that their importance and their latent power for doing good have been made sufficiently clear.

Mr. W. H. Dittoe, chief engineer, Ohio State Department of Health, presented the following paper:

THE TYPHOID FEVER EPIDEMIC AT SALEM.

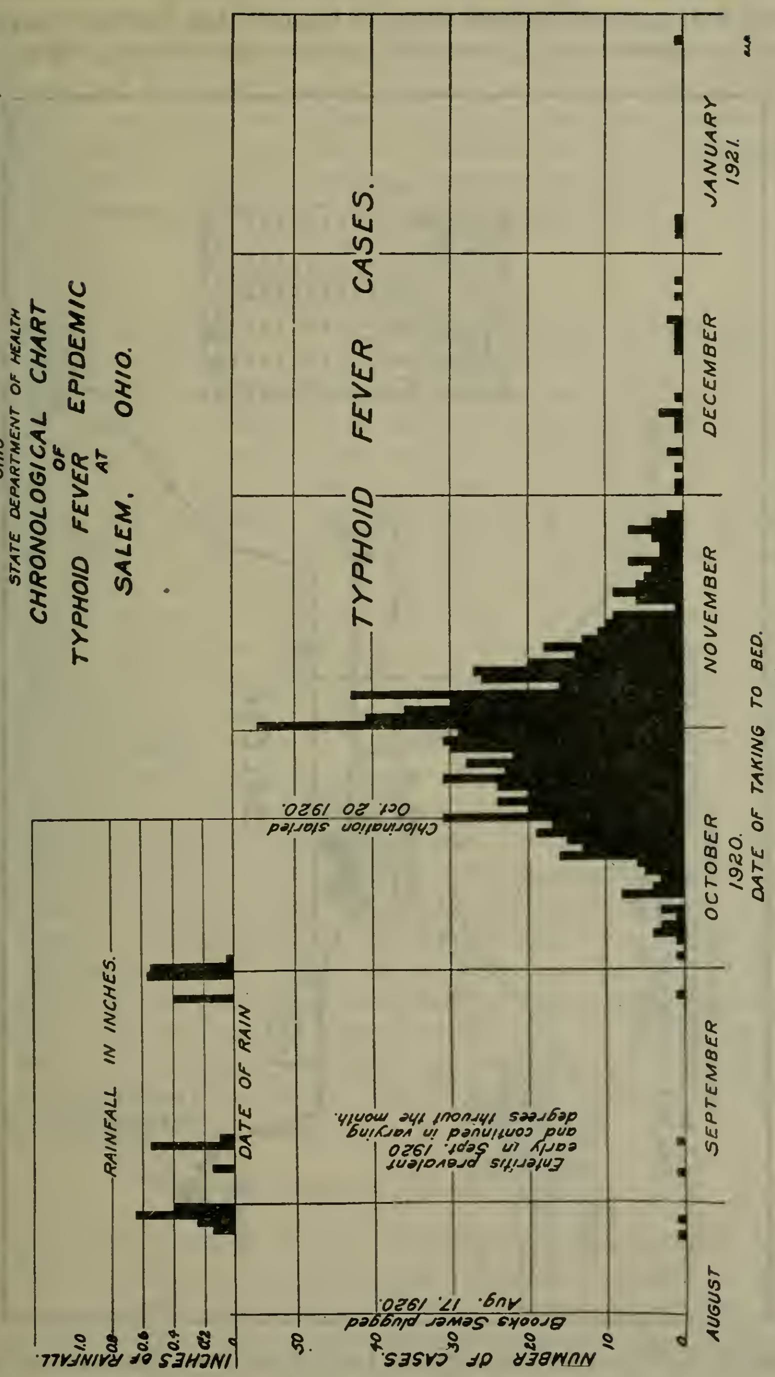
The epidemic of typhoid fever which occurred at Salem, Ohio, during the fall of 1920 is of unusual interest to persons engaged in public health work. This epidemic showed one of the highest case rates ever recorded and at the same time the mortality rate was the lowest of the important epidemics of the United States. The epidemic was caused through the medium of a public water supply which for many years had been of a high degree of purity and had never previously been held responsible for any water-borne disease. These features of the epidemic warrant a complete relation of the circumstances surrounding it and there is now in preparation an official report to be issued by the State department of health which will supply all details. Therefore, I shall not endeavor to discuss completely all phases of this epidemic and shall only relate the important circumstances, including a description of the water-supply system and the manner in which it became contaminated.

The city of Salem is located in Columbiana County in the northeasterly portion of Ohio at the headwaters of Little Beaver River, a tributary of the Ohio River. The population of the city is about 10,000. It has a thriving industrial development, but its rate of growth has been rather slow. In addition to its public water supply system the city has a system of sewerage constructed on the separate plan and also has a number of paved streets. The sanitary sewers cover practically all of the built-up area and serve a population of about 9,000. Sewage is delivered to a sewage-treatment plant located northwest of the city, consisting of tanks and intermittent sand filters, the effluent from which is discharged into a small creek. This plant is inadequate, and, moreover, it has been greatly overburdened due to the misuse of the sanitary sewers. The city has neglected to control sewer connections and as a result these connections have been established very carelessly and have permitted large volumes of surface and subsoil drainage to reach the sewers. In addition, there are several poorly constructed private sewers connected to the system. It will be shown later that the improper control of sewerage was a contributing cause to the occurrence of the epidemic.

HISTORY OF EPIDEMIC.

During the early part of September, 1920, an outbreak of enteritis occurred in Salem and was observed by the local physicians and the health commissioner. This outbreak was not intense, and as cases of intestinal disorders were more or less prevalent in other communities nearby no particular concern was aroused. It was thought by local physicians and health officials that the sickness was "intestinal influenza," but in the light of facts later learned the Salem cases were without doubt of a different kind and due to an entirely different cause. After partial subsidence of this outbreak, a second and much more intense outbreak of enteritis occurred, starting about September 23 and consisting of approximately 7,000 cases. Typhoid fever made its appearance about October 1 and after October 12 the typhoid fever cases increased very rapidly, the epidemic mounting to a peak on November 1. Thereafter, a rapid decline occurred. The total number of typhoid-fever cases which were reported and investigated was 884, including not only the epidemic cases but those which preceded and followed the epidemic, a period of two months. The total number of deaths resulting from the epidemic was 27. Figure No. 1 illustrates graphically the course of the epidemic.

While investigation showed that the typhoid fever epidemic started about October 1, the actual existence of typhoid fever within the community was not known until October 13. In the early part of October the city health commissioner issued a public warning that the water from the public water supply should be boiled, but this warning was only based upon a policy of playing safe and was not the result of knowledge that the water was contaminated. In fact, at that time the water supply of the city was still considered to be above suspicion owing to its previous history. The State department of health was called upon October 13, 1920, to investigate the enteritis outbreak and in connection with this investigation, which was conducted by an epidemiologist of the department, the existence of a few cases of typhoid fever in the city was learned. Circumstantial evidence pointed to the public water supply as the cause for the enteritis and accordingly a boiling notice was repeated on October 15 and request was made by the epidemiologist for an engineering investigation of the water supply system. This was conducted as promptly as possible and included field analyses of water samples. The results of this study are shown graphically by figure No. 2. The result of this investigation fixed the water supply conclusively as the cause of the epidemic and accordingly disinfection of the water supply with liquid chlorine was decided upon and started October 20. It is pertinent to observe that at this time the local health department knew of



OHIO
STATE DEPARTMENT OF HEALTH
CHRONOLOGICAL CHART
OF
TYPHOID FEVER EPIDEMIC
AT
SALEM, OHIO.

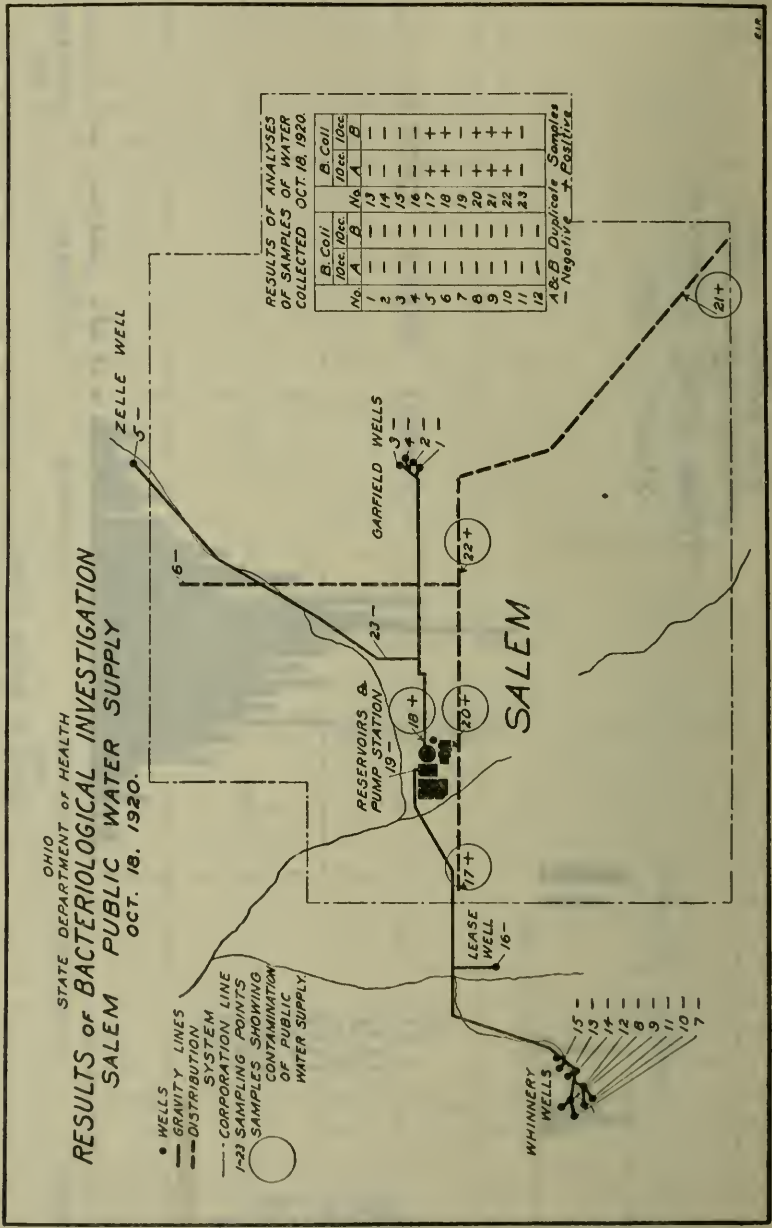
Brooks Sewer plugged Aug. 17, 1920.

Enteritis prevalent early in Sept. 1920 and continued in varying degrees thru'out the month.

Chlorination started Oct. 20 1920.

Fig. 1.

only four cases of typhoid fever in the city, but as the subsequent studies demonstrated about 100 persons were suffering from the disease at the time whose cases had either not been diagnosed or had not been reported. The disinfection of the public water supply checked the epidemic. It of course did not affect those persons who



RESULTS OF ANALYSES OF SAMPLES OF WATER COLLECTED OCT. 18, 1920.

No.	B. Coli 10cc. A	B. Coli 10cc. B	No.	B. Coli 10cc. A	B. Coli 10cc. B
1	−	−	13	−	−
2	−	−	14	−	−
3	−	−	15	−	−
4	−	−	16	−	−
5	−	−	17	+	+
6	−	−	18	+	+
7	−	−	19	−	−
8	−	−	20	+	+
9	−	−	21	+	+
10	−	−	22	+	+
11	−	−	23	−	−
12	−	−			

A & B Duplicate Samples
− Negative + Positive

FIG. 2.

had received infection previous to October 20, but it prevented further infection, and subsidence of the epidemic occurred on schedule time. The size of the epidemic was not realized until the early part of November when reports of cases multiplied, and on November 9 at the request of the city officials the State department of health assumed charge of the local situation and sent representatives to make a thorough investigation and to apply necessary remedial measures to prevent the spread of the disease.

SANITARY INVESTIGATIONS.

When the representatives of the State department of health undertook the investigation on November 9, practically no accurate information regarding the epidemic was available except the knowledge that the public water supply had been the medium of infection and that by instituting chlorination on October 20 this cause of the disease had been removed. It became necessary, therefore, to institute a careful inquiry regarding the situation throughout the city, and for this purpose what has been termed a sanitary investigation was made. This comprised a visit to each occupied building within the city and in the built-up district surrounding the city, a total of 2,630 places. Informaton was obtained regarding cases of illness and the nature of the same occurring after September 1; the source of the water supply used prior to illness, the existence of a water service connection, a private well or other private source of supply, and the existence of a sewer connection, privy or cesspool. In addition, printed notices were left at each place, containing a warning to boil all water used for drinking and giving instructions regarding disinfection of stools from typhoid fever patients. This sanitary investigation would not have been possible had it not been for the earnest effort of the local war workers organization. By the united effort of the members of this organization, the sanitary investigation was practically completed during a period of 24 hours making the information promptly available. The results of this sanitary investigation gave information which was the basis upon which the epidemiological investigation was made and the various remedial measures were applied to check the spread of the disease.

EPIDEMIOLOGICAL INVESTIGATION.

Starting on November 9 and continuing until the epidemic had subsided, a careful and thorough epidemiological investigation was made of each case. The usual information regarding each case was secured, consisting of the date of first symptoms, the date taken to bed, the location of the case, the sex, age, and color, and an inquiry to determine the possible exposure factors during the period when the disease was contracted. These factors included the milk supply, the food supply, the water supply, the attendance at public gatherings, and the opportunity for contact infection. I shall not endeavor to present any details of the results of the epidemiological investigation. All sources of infection were clearly eliminated, except the public water supply of the city, which was found to be the common factor. The chronology, distribution, and general character of the epidemic also pointed to the public water supply as the cause. Therefore the evidence established the epidemiological diagnosis "that the contamination of the public water supply was the cause of the epidemic."

DESCRIPTION OF WATER SUPPLY.

The following description of the public water supply system of Salem applies to the system as it existed prior to the epidemic and does not include the changes or improvements made subsequently. The Salem Water Co. started the development of the present system in 1887, continuing its ownership until 1899, when the Salem Water Works Co. succeeded to ownership. In 1909 the system became the property of the city. The water supply is obtained from four general sources, as follows: The Garfield Avenue wells, located immediately northeast of the central portion of the city; the Whinnery wells, located approximately one-half mile west of the city; the Lease well, located approximately one-quarter mile west of the city; and the Zelle well, located immediately north of the city. The water is lifted from the various wells either by air-lift or deep-well pumps and delivered by gravity lines to storage reservoirs located near the main pumping station in the westerly portion of the city, and from these reservoirs the supply is pumped to the distributing system. The general locations are shown by figure No. 2.

The Garfield Avenue wells are very poorly located, being on a tract of land occupied by a high-school building and in a district which is entirely built up with residences many of which are accompanied by privies and abandoned private wells. There are also sewers and other contaminating influences near the wells. Wells were developed at this site as early as 1882, before the water company assumed control, and these were continued in use until 1898, when additional wells were drilled and the old wells deepened. At this time the water was pumped from the wells directly into the distributing system, but in 1900 air-lift equipment was installed to pump the wells and a gravity line was constructed extending from the site of the wells to the reservoirs at the main pumping station. The wells have been operated in this manner since 1900. The Garfield Avenue wells are 265 feet in depth, penetrating 12 feet of clay, 100 feet of brown sandstone, 80 feet of fire clay or soapstone, and extending the rest of the way through white sandstone. The casings

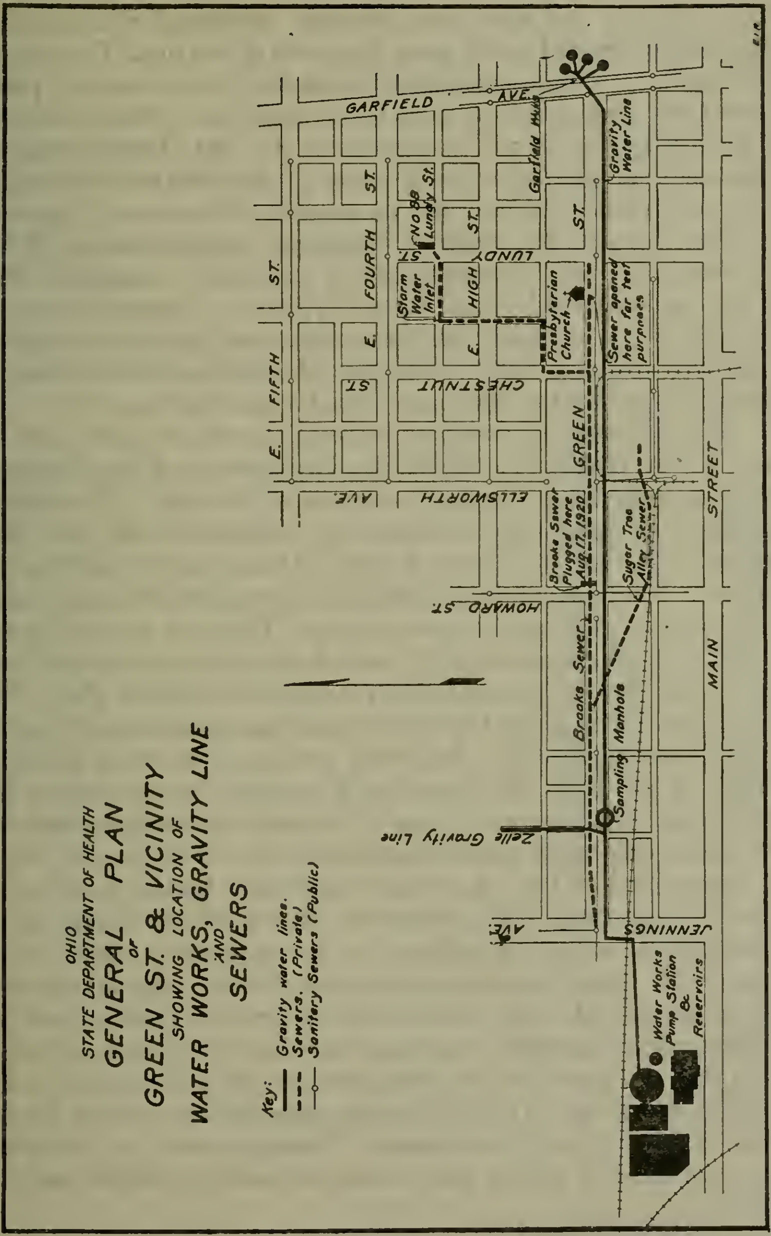


FIG. 3.

of the well extend to a depth of about 100 feet and the water is mainly derived from the white sandstone. The gravity line has a total length of 3,400 feet and is constructed of 12-inch vitrified saltglazed double-strength sewer pipe in 3-foot lengths, with deep and wide sockets. Joints were made with cement. The line extends in Green Street and Jennings Avenue, both of which are almost completely built up, and there are numerous sources of contamination of the shallow ground water along the route of the line. Private and public sanitary sewers parallel and cross the line and are at points at elevations higher than that of the gravity line. The location of the gravity line is shown by figure No. 3. The Garfield well development is unsatisfactory on account of the unfavorable location of the wells themselves and also on account of the use of a gravity line which subjects the water to dangerous contamination. While these conditions were recognized to be potentially dangerous, they had not caused trouble prior to the epidemic. Samples from the wells collected at various times during the past 20 years have given satisfactory results and this is also true of samples collected from the reservoirs receiving the discharge from the gravity line.

In 1903 it became necessary to increase the water supply and the Salem Water Works Co. started the development of the Whinnery wells at a point about one-half mile west of the city. The original installation comprised six wells and five additional wells have been installed from time to time since 1903. The site of the wells is satisfactory. The surrounding country is open farm land and there are no near-by sources of contamination. The wells are 180 feet to 200 feet in depth, penetrating 85 feet of clay, 80 feet of white sandstone, a few feet of limestone, and a stratum of black slate. The supply is obtained from the white sandstone formation. Four of the wells are pumped by deep-well pumps and six of them are pumped by air lift. The water is discharged into a gravity line which extends a distance of some 5,700 feet in an easterly direction to the reservoirs at the main pumping station. This gravity line is well constructed of 10-inch cast-iron pipe with leaded joints and is probably water-tight. The fittings at the top of the casings of the wells equipped with deep-well pumps are apparently tight. Brick cisterns with plank covers are placed around the tops of the wells pumped by air lift. The covers are not securely fastened and are not tight, and the cisterns in general have been permitted to deteriorate so that the water as discharged from the wells is exposed to possible contamination. This is the only unfavorable sanitary feature of the Whinnery well development. Samples from the Whinnery wells have always shown this supply to be of excellent sanitary quality.

The Lease well, which is located about one-quarter mile west of the city between the Whinnery wells and the city, was developed in 1914 and is similar to the Whinnery wells. It is pumped by air lift and is provided with a brick cistern. The same comment made in regard to cisterns at the Whinnery wells applies to this development. Samples from the Lease well have always shown freedom from contamination.

During 1916, the city increased the available water supply by drilling wells on the Zelle farm, located immediately north of the city. The location of these wells is satisfactory and the city owns a 24-acre farm at this point. Only one well is now in service. This is approximately 180 feet in depth and penetrates 35 feet of sand and gravel, 5 feet of shale, an unknown thickness of brown sandstone, and an underlying soapstone formation. The well is plugged at a depth of 165 feet. The water is obtained from the brown sandstone formation. The well is pumped by direct suction, the water being discharged into a gravity line constructed of 6-inch cast-iron pipe with leaded joints and extending from the well site in a general southwesterly direction to a connection with the old vitrified pipe gravity line serving the Garfield Avenue wells. From this point the combined flow of the Garfield Avenue wells and the Zelle well is conveyed in the vitrified pipe line to the reservoirs at the pumping station. The tops of the wells at the Zelle farm are not securely closed to prevent entrance of chance contamination, but otherwise the well development is satisfactory. The gravity line is poorly located as it extends along the banks of a small stream and is, therefore, subject to washout. Evidence also indicates that the joints of this line were not made properly and that many of them are leaky.

The water from the various sources of water supply delivered through the gravity lines is received in storage reservoirs constructed at various times between 1887 and 1917. These comprise reservoir No. 1, a circular structure 91 feet in diameter and 12 feet in depth with a stone wall and a concrete bottom and cover; reservoir No. 2, a rectangular structure 100 feet by 70 feet in plan and 14 feet deep with concrete floor, walls, and cover, and reservoir No. 3, a rectangular structure 159 feet by 107 feet in plan and 10 feet deep with concrete floor, walls, and cover. In addition, there is a pump well 36 feet in diameter and 16 feet deep with a concrete floor, brick walls, and timber cover from which the pump suction is normally taken. The reservoirs are so connected that water may be discharged into either reservoir No. 1 or No. 2 and may be drawn to the pumps from the suction well or from reservoirs No. 2 or No. 3. The general arrangement of the reservoirs is shown in figure No. 4.

The condition of the reservoirs and suction well is not satisfactory. The bottoms of all of the reservoirs are in a leaky condition and the walls of reservoirs No. 2 and No. 3 and of the pump well are also leaky. This permits the entrance of shallow ground water into the reservoirs when the water within them is lowered to an elevation below that of the surrounding ground water. This is of particular importance when it is known that the reservoirs are located at about the lowest elevation within the city, to which

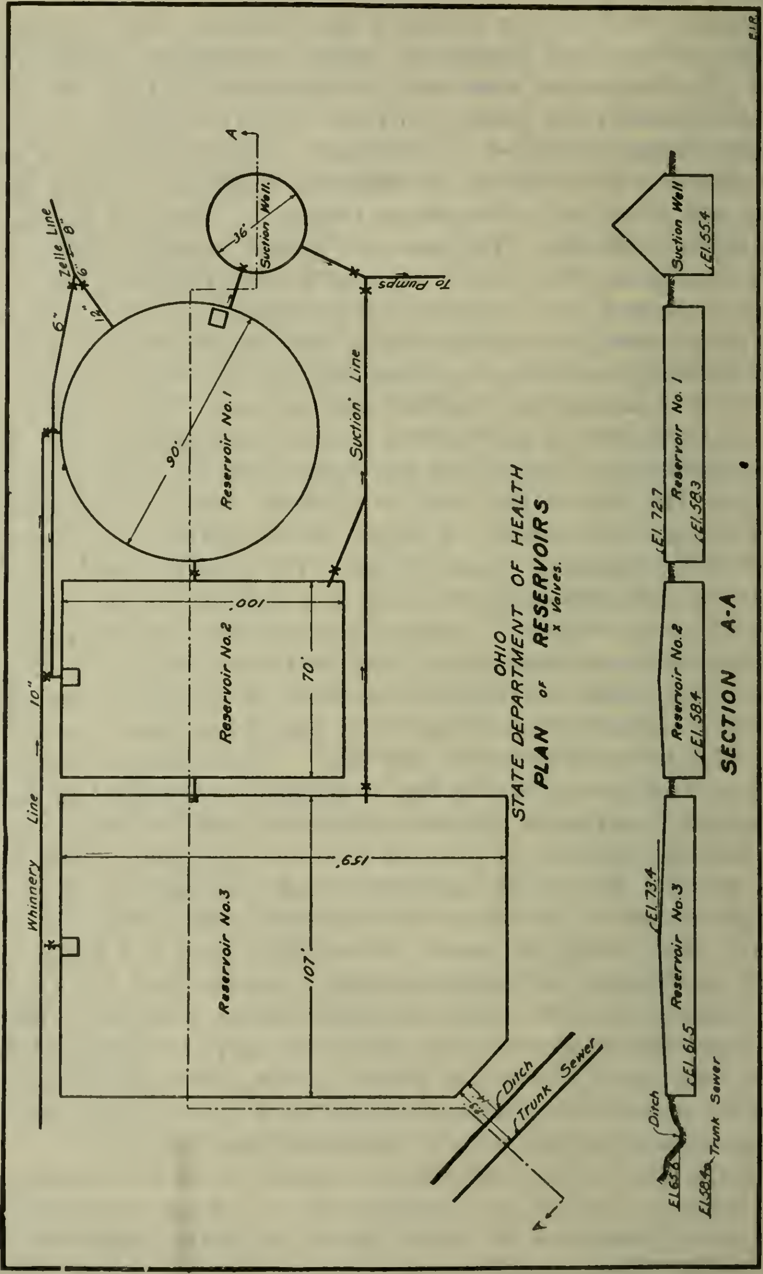


Fig. 4.

vicinity practically all of the natural and artificial drainage is directed. The main trunk sanitary sewer of the city passes reservoir No. 3 at a distance 23 feet from its west wall.

The water supply is in general use by the citizens of the city and prior to the epidemic was popularly accepted as a pure supply. It is also made available to the industrial plants of the city which generally maintain private supplies obtained from wells similar to those of the city. Careful investigation revealed existence of a number of cross connections with the public supply.

Summarizing the above description of the water-supply system of the city, it will be noted that while the water had for a number of years been considered safe due to favorable analyses and absence of outbreaks of water-borne disease, there existed at the time of the epidemic a number of defects in the development of the system. For convenience these will be repeated as follows:

1. The location of the Garfield wells is unsafe.
2. The gravity line serving the Garfield Avenue wells is of unsafe construction, probably not water-tight, and as it passes through the built-up portion of the city the water supply is thus rendered subject to contamination.
3. The tops of the various wells are not securely closed.
4. The iron pipe gravity line serving the Zelle well is poorly located and has poorly leaded joints.
5. The reservoirs have leaky walls and bottoms, subjecting the water supply to danger of contamination by shallow ground water.
6. Connections to the waterworks mains exist whereby private water supplies may reach the distributing system.
7. While not directly connected with the sanitary safety of the water supply, mention must be made of the inadequacy of the supply which has caused several severe shortages during recent years.

MANNER IN WHICH THE WATER SUPPLY BECAME CONTAMINATED.

Recognizing the various defects of the waterworks system it became necessary to determine beyond reasonable doubt the manner in which the public water supply became contaminated and thus caused the epidemic of typhoid fever. The investigations and studies of this matter required much time and painstaking care and obviously consideration of each defect was demanded. The first investigation made October 18 and 19, including bacteriological examination of samples, indicated that the contamination was reaching the water supply through the vitrified pipe gravity line serving the Garfield Avenue wells and these results warranted the presumption that this was the cause of the epidemic. Figure No. 2 shows these results. Accordingly, in addition to chlorinating the water supply, beginning October 20, the use of this gravity line for the Garfield Avenue wells was terminated October 27 as soon as pumping equipment could be delivered directly into the distributing system. It was necessary to continue the use of the lower portion of the vitrifield pipe gravity line for conveying the water from the Zelle well until December 3, when a new cast-iron line was completed. A careful consideration of the various defects of the waterworks system finally eliminated all causes for contamination except the vitrified pipe gravity line. Taking up each of the defects it may be advantageous to indicate how they were eliminated.

The possibility of deliberate or accidental contamination of the water supply through the tops of the well casings can not be eliminated definitely, but this does not appear as a probability, particularly in view of the fact that the history of the epidemic indicates that the water supply was infected on more than one occasion during the time the outbreak was developing.

Direct contamination of the Garfield Avenue wells probably did not occur, as samples collected from them for a long period of years prior to the epidemic and during the period of investigation after the epidemic started did not show contamination.

The cast-iron-pipe gravity line serving the Zelle well under certain circumstances might have admitted contamination through a leaky joint, but this possibility is removed by the evidence that the line was under internal pressure continuously from the spring of 1920 until October, 1920, at points where it would be possible for contamination to reach the line. Furthermore, analyses of samples from this line failed to show contamination.

The cross connections on the distribution system permitting discharge of water from private industrial water supplies are not held accountable due to the fact that these supplies are generally of the same character as the deep-well supplies of the city, and, furthermore, the distribution of cases throughout the city would not correspond with contamination in this manner.

In spite of the unsatisfactory construction of the reservoirs and pump well at the main pumping station, a careful investigation produced evidence showing that these structures were not responsible for the typhoid fever outbreak. Evidence was obtained showing that at no time during the summer of 1920 did the level of water in the reservoirs fall below that of the shallow ground water surrounding them. A test was conducted to determine whether it would be possible for sewage to pass from the main sanitary trunk sewer of the city to reservoir No. 3. This was done by plugging the sewer so as to place it under a head of 6 feet, adding at the same time to the sewage a considerable quantity of uranine, which is a very intense green dye. Previously, reservoir No. 3 had been completely emptied, and it was noted that shallow ground water seepage entered through the walls and bottom. This condition was permitted to continue for slightly more than one hour, and samples of the seepage reaching the reservoir were regularly collected, but failed to show evidence of the uranine color.

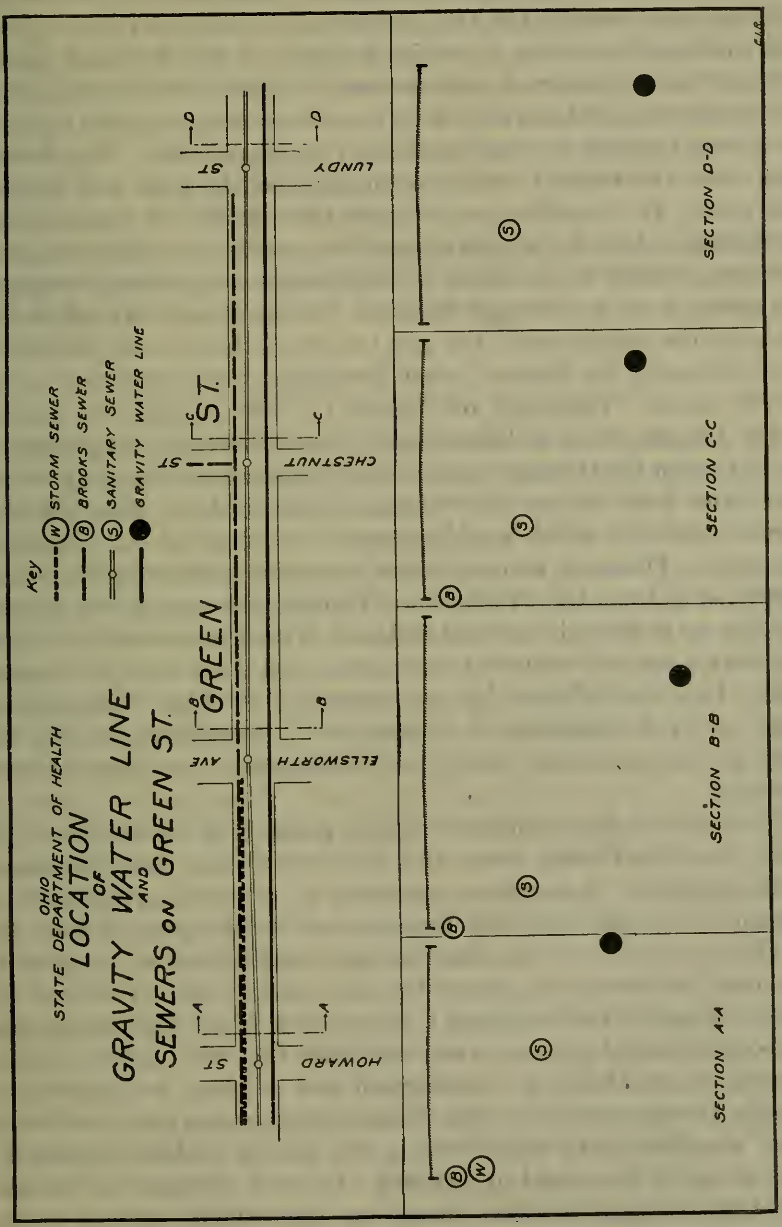


Fig. 5.

The study of the vitrified pipe gravity line serving the Garfield Avenue wells gave conclusive results that the water supply was contaminated by leakage of sewage into this line. This line extends in

Green Street and is paralleled by a sanitary sewer, a storm sewer, and two private sewers. One of these private sewers, known as the Brooks sewer, was installed a number of years ago for private use, but was later connected to the sanitary sewer system of the city and was continued in use as a combined sewer. Not only did it receive sewage from a number of residences and a church, but it also received the surface run-off from a built-up area of several acres, this reaching the sewer through a catch basin near its upper end. The Brooks sewer was constructed with open joints and the pipe was without bell ends. It, therefore, must have been leaky. A storm sewer parelleling it had discharged sewage for several years and a nuisance had been created at the outlet. This sewage was probably reaching the storm sewer by seepage from the Brooks sewer. An effort was made by the employees of the city to correct these conditions, but it was impossible to discover what dwellings were connected to the Brooks sewer. Therefore, on August 17, 1920, a plug was inserted in the Brooks sewer at Howard and Green Streets by employees of the city, with the thought in mind that sewage would back up in this sewer and flood cellars of dwellings connected to it, thus bringing about complaints which would expose the existence of connections to the sewer. However, no complaints arose and apparently the sewage continued to leave the Brooks sewer through the open joints without backing up sufficiently to flood cellars. With these conditions existing heavy rainfall occurred during the last four days of August, 1920. This was followed by an outbreak of enteritis. Other heavy rains occurred September 9, September 27, September 30, and October 1, and apparently were the forerunners of the typhoid-fever epidemic.

While all of the evidence strongly pointed to soundness of the belief that the Brooks sewer and the gravity line were the causes of the epidemic, it appeared necessary to prove the possibility of passage of sewage from the Brooks sewer to the gravity line. In an effort to do this a sampling manhole was placed on the gravity line near its lower end, where the seepage leaving it could be observed, sampled, and measured. It was soon found that the seepage was contaminated ground water and that the rate of flow was influenced by rainfall. A concentrated salt solution was introduced into the Brooks sewer above the plug and at the same time the Brooks sewer was filled with water from a fire hose to imitate surcharging such as would be caused by rainfall. Careful examination of samples from the gravity line showed an appreciable increase in the chlorine content, 30 parts per million being present before the test and 46 parts per million after the salt was applied. This was not considered to be sufficiently conclusive, and further tests were made using uranine. This was applied at the storm-water inlet to the

Brooks sewer, at the same time filling the sewer with water from a fire hose. Within two hours after this dye was applied at the storm-water inlet a definitely noticeable green discoloration appeared in the seepage from the gravity line at the sampling manhole. Allowing for the time for flow in the Brooks sewer and in the gravity line between the storm-water inlet and the sampling manhole, the time for transfer from the Brooks sewer to the gravity line could not have exceeded 30 minutes. These investigations established conclusive evidence that the typhoid epidemic at Salem was caused by the passage of sewage from the Brooks sewer to the gravity line. Important confirming evidence is furnished by the fact that about October 1 there was a case of typhoid fever in a dwelling connected to the Brooks sewer, the stools from which were flushed directly into this sewer.

MEASURES TAKEN TO CONTROL THE EPIDEMIC.

The placing in operation on October 20 of a disinfection plant to treat the public water supply of the city at the main pumping station effectually checked the epidemic. This was the most important step taken to prevent the continued spread of the disease. Added safety was secured by abandoning the use of the vitrified pipe gravity line for delivery of water from the Garfield Avenue wells on October 27 and by the reconstruction of the lower end of this line, using cast-iron pipe, which was placed in service for the delivery of water from the Zelle well on December 3. An added measure of safety was provided by placing in operation on December 11 a liquid chlorine machine to treat the water pumped from the Garfield Avenue wells into the mains. Daily analyses of the water as delivered to the consumers indicated that after the disinfection of the supply was started the water was safe for drinking purposes at all times.

Owing to the intensity of the epidemic, however, and particularly recognizing the results of the sanitary investigation, it was deemed advisable to place in effect other measures to prevent the spread of typhoid fever. The sanitary investigation revealed the existence of some 276 private dug wells, 127 private drilled wells, and many cisterns throughout the city. The majority of these wells and cisterns were old and unused prior to the epidemic, but owing to the suspicion which was aroused regarding the public water supply the people generally turned to private sources of drinking-water supply. Accordingly, it was felt that some definite measures should be taken to protect the inhabitants of the city from disease which might arise from the use of such private supplies, as such supplies were in constant danger of contamination by the discharges of typhoid fever patients. Public warnings were given against the use of dug wells and springs, and in addition 100 dug wells and 37 cisterns were disinfected by applying to each 1 pound of hypochlorite of lime. This effectually prevented the use of such wells.

The sanitary investigation revealed the existence of 441 privies the most of which were of improper construction. As it was thought that many of these had been used by persons suffering from typhoid fever infection, it was deemed advisable to attempt disinfection of these privies. Accordingly, each privy vault in the city was treated with approximately 5 pounds of hypochlorite of lime.

Particular emphasis was placed upon the disinfection of stools from typhoid fever patients and to facilitate this, a supply of hypochlorite of lime in 1-pound tins was secured by the city and distributed without cost to families in which cases of typhoid fever existed.

It was not known what effect the sewage from the city might have upon the population downstream from Salem and it was deemed justifiable to attempt disinfection of the sewage at the sewage treatment plant. For this purpose, a dry feed chlorine gas machine was installed to treat the settled sewage. The amount of chlorine applied was approximately five parts per million which was the maximum capacity of the machine. No bacterial results are available to show the efficiency of this treatment. On the Ohio River below the mouth of Little Beaver River are several communities in Ohio and West Virginia obtaining their public water supplies from the stream. These communities were notified of the existence of the typhoid fever epidemic in order that they might take precautions in the treatment of their water supplies.

Pasteurization of the entire milk supply of the city was effected. Fortunately, a large milk depot had been established at Salem and was equipped with efficient pasteurizing machines making possible the treatment of the entire milk supply of the city. Regulations were also enforced prohibiting the leaving of milk containers at premises where typhoid fever existed, and prohibiting delivery of containers to purchasers at groceries and other places selling milk. These measures continued in effect until the epidemic had subsided.

Prevention of the spread of the disease through contact is attributable to the efficient public health and private duty nursing service which was provided. Over 300 nurses responded to the general call for help and as a result every patient in the city received daily nursing attention. Too much credit can not be given to the nursing service for the prevention of the spread of the disease through contact and for the low mortality rate.

Inoculation was generally taken advantage of by the people. It is estimated that at least 4,000 persons were inoculated. These included all of the food handlers of the city.

Unusual medical service attended the treatment of this epidemic. The 17 local physicians were assisted by 3 volunteer physicians from neighboring cities and 6 consultants. Dr. Henry A. Christian of Boston, Mass., did most to accomplish the proper treatment of the cases to which must be attributed in a large measure the low mortality rate. Hospital facilities included five hospitals, four of which were improvised. The total capacity, 180 beds, was taxed during the peak of the epidemic.

RECOMMENDATIONS MADE TO PREVENT A RECURRENCE OF THE EPIDEMIC.

The outstanding recommendations made by the State department of health to the city officials to prevent possibility of a recurrence of the typhoid fever epidemic relate to improvement of the public water supply system. The following were the principal items of advice regarding the water supply:

1. To continue chlorination of the water supply until improvements in the system could be made which would insure a safe water supply at all times.
2. To provide extensive improvements of the water supply system to insure an adequate water supply of good quality and pending the completion of such improvements to take the following steps:
3. To abandon permanently the Garfield Avenue wells, requiring increase of the other sources of water supply.
4. To abandon permanently the vitrified pipe gravity line. This has been done.
5. To repair the cast-iron pipe gravity line serving the Zelle well field.
6. To protect all wells from contamination by securely closing the tops of casings.
7. To abandon or make water-tight the storage reservoirs at the main pumping station.
8. To require abandonment of unsafe private wells.

The foregoing recommendations have not been fully carried out to date, but the city has learned its lesson and is taking steps to follow these recommendations fully.

In addition, recommendations were made to the city that legislation be passed providing for the proper control of the use of the sewers of the city in order to secure the use of the same in accordance with the purposes for which they were designed. Progress has been made looking toward the carrying out of these recommendations.

In order to provide proper control of the milk supply, sanitary inspection of dairies by the city was recommended and continued pasteurization of the milk supply to the city until the epidemic had entirely subsided.

LESSONS LEARNED FROM THE EPIDEMIC.

While the epidemic involved a great loss in life, money, and efficiency, it produced facts the recognition of which will prevent the occurrence of other epidemics of similar cause. The outstanding fact is the necessity of proper construction and maintenance of public water supply systems. No city can afford to overlook this fact. All features of construction and maintenance of the water supply system must be of highest standard to insure continuous safety. Another lesson learned is the necessity of analysis of the public water supply at regular intervals, regardless of its reputed quality. Had these lessons been learned and followed at Salem prior to the epidemic, it is safe to say that the epidemic never would have occurred.

As a result of the Salem experience the General Assembly of Ohio in 1921 passed a law intended to provide better control of public water supplies in Ohio. This law contains the following principal features:

1. It gives the State department of health general supervisory control of all public water supplies.
2. It requires the municipality or owner of the system to have analyses made regularly.
3. It prohibits dangerous emergency supplies and cross connections between public and private water supply systems.
4. It empowers the State department of health to require changes and improvements in public water supply systems to insure safety.

It is believed that the proper enforcement of this law will accomplish much in the prevention of water-borne typhoid fever in Ohio.

Afternoon Session, June 1, 1921.

The conference reconvened at 2 p. m., Mr. Whittaker presiding.

Mr. Dittoe submitted the following report:

REPORT OF COMMITTEE ON WATER SUPPLIES.

The committee on water supplies has given careful consideration of the proper subject to be treated in its first report to the conference and has decided that this report should be general in nature and should outline the activities which a State health department should conduct in undertaking comprehensive control of water supplies. In subsequent reports, technical and detail questions coming properly under the scope of this committee may be persented:

PRESENT PRACTICE OF WATER SUPPLY CONTROL IN THE VARIOUS STATES.

For the purpose of ascertaining the present activities and methods employed in the various States in the control of water supplies, your committee submitted inquiries to each State health department. Replies were received from 39 States and your committee has general information concerning the activities carried on in two of the States not replying. Your committee, therefore, has available information regarding all but seven of the States.

A review of the existing practice in the various States gives the following information: Some 35 States have established in their health departments a division of sanitary engineering. With the exception of a few of the older and more populous States the divisions of sanitary engineering are inadequately manned. At least 12 States have divisions comprising a single engineer and the great majority of the divisions include a chief engineer with one to five assistant engineers. In each State having a division of sanitary engineering, control of water supplies is practiced, the completeness and effectiveness of which varies with the adequacy of the personnel. The approval of plans for proposed public water supply improvements is required in almost all of the States, and in about half of the States the department is given the power to order improvements in public water supplies when found necessary. The extent of control of existing water supplies varies greatly in the different States, and in many of them practically no State control is possible due to inadequate personnel. It is the general practice in the various State health departments to maintain a division of laboratories and to have all laboratory analytical work on water supplies performed by this division. In a few instances, however, a water laboratory is maintained as a part of the division of sanitary engineering.

The general conclusion from a study of the information furnished to your committee is that in most instances the divisions of sanitary engineering of the State health departments are inadequately manned to perform the duties which logically should rest upon such divisions. Additional personnel is necessary to provide adequate water supply control, to say nothing of the other important functions of such divisions. Judging from the replies received to its inquiries, your committee is of the opinion that it will be beneficial to list the activities which are considered necessary in providing comprehensive and effective control of water supplies by a State health department. Your committee recognizes that many members of this conference are fully informed regarding the phases of water supply control work which are necessary or desirable, and hopes that it may be pardoned for presenting more or less elementary principles. It is the judgment of the committee, however, that this presentation will be of assistance to many State health departments in coordinating water supply control work and in extending and enlarging the functions of the divisions of sanitary engineering.

RECOMMENDED ACTIVITIES OF STATE HEALTH DEPARTMENTS IN CONTROL OF WATER SUPPLIES.

The completeness and effectiveness of control of water supplies by a State health department may be measured by the reduction in typhoid fever death rates. Complete and effective control will not only prevent recognized epidemics of typhoid fever but will accomplish a steady reduction in the number of scattered cases of the disease. The latter result will, in fact, ordinarily produce a greater reduction in rates than the reduction due to prevention of epidemics.

It is, therefore, the judgment of your committee that complete and effective control of water supplies should be provided in every State, regardless of other duties imposed upon the division of sanitary engineering. Complete control of water supplies used by the people of a State demands recognition of (1) the public water supplies, those serving municipalities, districts, and communities; (2) quasi-public water supplies, those serving institutions, schools, factories, and other public and quasi-public buildings, and places used for the assemblage or employment of persons, and (3) private sources of water supply installed for the use of individual families. Bottled waters used for drinking, beverage, and medicinal purposes should be considered as quasi-public water supplies.

Following is an outline of the activities which your committee recommends to provide for effective control of water supplies by the State health department:

1. Approval of proposed public and quasi-public water supplies by State health department.

(*a*) Approval of the source of supply and the plans for its development, including its purification.

(*b*) Approval of the installation after it is completed and ready for use. (This is to insure that the work has been performed in accordance with the approved plans.)

2. Supervision of existing public and quasi-public water supplies by State health department.

(*a*) Inspections by the State health department to cover the following features:

(1) Adequacy of the supply.

(2) Possibility of contamination of source.

(3) Possibility of contamination due to improper development.

(4) Possibility of contamination due to inefficient purification works.

(5) Possibility of contamination in distribution—for example, by cross-connections, unsafe reservoirs, etc.

(6) Possibility of contamination due to emergency supply.

(7) Sanitary quality determined by analyses made in the field and in the department laboratory.

(8) Extent of use of the supply and for what purposes.

(*b*) Submission of reports to State health department by local officials.

(1) Reports on operation of water purification plants.

(2) Reports of regular analyses of water supply made in laboratories other than that of the State health department.

(3) Plans and records of existing works when required by the State health department.

(*c*) Issuance and enforcement of orders and regulations by State health department.

(1) Requiring proper general maintenance of system, such as flushing of mains, cleaning of reservoirs and standpipes, removal of cross connections, etc.

(2) Requiring proper supervision, analytical control, and operation of water purification plants.

(3) Requiring abandonment of emergency intakes and pending such abandonment, requiring proper control of the use of the same.

(4) Requiring improvements to correct unsafe development of the supply, such as open well tops, leaky and unprotected reservoirs, leaky gravity lines, etc.

(5) Requiring abandonment of water supplies found to be impure and dangerous to health, and the installation of a satisfactory supply or a water-purification plant.

3. Investigation by the State health department of the necessity of public water supply systems in municipalities and districts not provided with a public water supply. Based upon such investigations local officials should be urged to provide satisfactory public water supply improvements.

4. Effective control of water supplies demands control by the State health department of sewerage, sewage disposal, and industrial wastes disposal. Such control should include approval or disapproval of proposed projects and enforcement of orders requiring improvements necessary to correct and prevent contamination of water supplies. This phase of work is wholly distinct from control of sewerage and disposal of sewage and industrial wastes for the purpose of preventing stream pollution and nuisances.

5. Application by the State health department of remedial measures to suppress water-borne typhoid fever epidemics.

6. Examination and approval by the State health department of water supplies for drinking and culinary purposes for common carriers. This work is to be carried on in cooperation with the United States Public Health Service.

7. Attention to private water supplies by the State health department is necessary, but the direct control of such supplies should be practiced by the local health officials. They should examine them and order their abandonment or improvement when necessary. It is the proper function of the State health department to furnish general information regarding the proper location and development of private water supplies and your committee advises that this may be best accomplished through bulletins. The State health department should also actively urge the abandonment of private water supplies when a public water supply of satisfactory quality is available.

The placing in effect of all of the above-listed activities can not be accomplished at one time and without great effort. In most cases it will be found necessary to select the most important activities to be undertaken first and to be followed by the addition of those activities which are considered to be of lesser importance. The enactment of basic legislation and the adoption of regulations are primarily required. In addition, adequate funds and competent personnel are necessary. In any case it is advisable that a program of development be adopted which will ultimately result in undertaking all of the activities recommended.

A motion was made, seconded, and approved that the above report be accepted by the conference as a progress report.

Prof. George C. Whipple of Harvard Engineering School presented the following paper:

STATE SANITATION.

State sanitation is so rapidly becoming a feature of our American Government, and the zest for health measures is becoming so great, that a consideration of certain fundamental principles by this conference of sanitary engineers should be not only appropriate but profitable. I therefore take the liberty of calling attention to some of the governmental principles which, though generally accepted, are often overlooked, and of expressing my personal opinion on certain matters of administration about which different views are held by different classes of people and in different parts of the country. What I have written is taken largely from a course of lectures on municipal engineering administration which I have given for several years at Harvard University.

HEALTH AND COMFORT OF THE PEOPLE.

By State sanitation is meant the efforts which State governments exert to prevent insanitary or uncleanly conditions of human environment which tend to impair the health or which are prejudicial to the comfort of the people. It is important, in the first place, to link these two terms together—the health and comfort of the people—for sanitation is concerned with them both. The two words are bound together in laws and legal decisions, as well as in common parlance. Nuisances are infringements against comfort as well as against health. Health, in its broadest sense, is something more than the absence of disease; it has a positive side. We measure health inversely in terms of sickness and death; we are beginning to attempt to measure health in terms of physical efficiency, capacity to work, and ability to enjoy life. The latter belong on the front side of the shield; sickness and death are for the back side. Both sides of the shield should be guarded.

Comfort has to do with the senses. Human discomfort is hard to measure, especially as people differ as to their sense reactions under different environments. These sense reactions are an important part of life; and the courts are sound when they decide that insanitary conditions are " prejudicial to health," even though the sense reaction may be merely that of a disagreeable odor. Bad odors from faulty plumbing or from badly ventilated rooms, bad odors in water supplies, bad odors from industrial plants, excessive noise, smoke in the atmosphere, oil deposits along the banks of streams and shores, and many other sense-offending conditions may be public nuisances and are properly included within the legal scope of "health and comfort of the people." I believe that sanitary engineers, who by their training are inclined to think in mathematical terms and have a penchant for measuring sanitation in terms of death rates, need particularly to be reminded of this aspect of sanitation.

POLICE POWER AND PUBLIC BENEFIT.

The police power is one of the inherent powers of government, that of protecting the people from dangers from within. Under it the Government may coerce the individual, take away his liberty, his property, and even his life, if necessary, in order to safeguard the safety, health, or morals of the people. Since the time of Magna Charta the English-speaking race has been preserved from tyrannous oppression, from undue exercise of the police power, by what is called "due process of law."

In the United States the police power originates in the State. It is exercised directly by the legislature, as representing the people. It may be delegated to some State department or official, to some city or city department, or to the National Government. Fundamentally, however, authority to act under the police power must be traced back to the State government.

Another function of government is that of doing for the people those things which the Government can do better, more cheaply, or more expeditiously than the people can do for themselves. These are acts for the public benefit, acts of public service, acts for the common good. They are paid for under the taxing power of government, another of its well-established functions. In recent years this idea of government has been greatly extended. Carried to the limit, it becomes paternalism or socialism. Many think it has been carried too far even in matters of health and comfort, and I am in sympathy with this view.

The two ideas of force and service represent the masculine and feminine elements of government. The best government results from a proper combination of the two. State boards of health, or departments of health as they are coming to be called, are concerned with both of these parts of government—health service and police power in behalf of health.

FUNCTIONS OF STATE HEALTH DEPARTMENTS.

State boards of health perform several functions. One of these is quasi-legislative in character, carried on under authority delegated by the legislature. A State board of health may be authorized to prepare a sanitary code, plumbing regulations, rules for the protection of water supplies, rules for reporting diseases dangerous to the public health, and the like. This is done because, in technical matters and in special fields where expert knowledge is needed, the legislature, composed of persons of varied attainments elected by the people, is less competent to enact such detailed legislation than a body of men selected for the special work at hand. For the best result, this delegated authority should be given to a body of men rather than to an individual. A health commissioner acting alone should not be allowed to perform functions which are legislative in character. Legislatures do well, however, to delegate authority for the preparation of rules and regulations which are essentially technical and scientific to competent boards rather than attempt to legislate directly.

A State board of health may act in a semijudicial capacity. This authority is seen in the matter of nuisances. The board may sit as a court, hold hearings, take testimony, and render decisions. Sometimes it sits as a court of appeal. In matters of this kind a board is better than an individual, as the decisions must often be based on facts and common judgment rather than on technicalities of science or law; that is, the board is a sort of judge and jury combined.

Of course there is much work of an executive character to be done by a State department of health. Some of this is incidental to the exercise of the police power—such as laboratory work, engineering, or inspection in connection with the oversight of water supplies, stream pollution, sewage disposal, nuisances, food sanitation, sophistication of food and drugs, statistical records of sickness and death.

In addition to these regulative functions much other work of quite a different character is done; vaccines and antitoxins are made and distributed; bacteriological diagnoses of certain diseases are made; nursing services are supervised; educational activities of various sorts are carried on. These works, done chiefly for the public benefit, are largely responsible for the increasing appropriations made to State departments of health. Further expansions of efforts of this nature are being considered in some States, such as maternity benefits, dental clinics, public health nursing, and the like. In my judgment, the wisdom of extending these activities is open to grave doubt. It is not at all certain that a State department of health is the organization best fitted to conduct popular education in health matters. It is certainly not the best organization to manage State hospitals and institutions. It is doubtful whether any form of activity which involves the operation of public utilities should be conducted by a State department of health. The attempt to combine the exercise of police power and the conduct of utilities for the public benefit involves administrative problems of serious character. In my opinion welfare work and public health work should be kept apart. Welfare work is done under the taxing power of government. Taxation for this purpose should be definite. If people want it or need it, let them appropriate money for it, knowing for what the money is to be spent. Let it not be confused in the public mind with money appropriated for the ordinary and well-understood police-power functions of health departments. In my opinion the time is coming when appropriations for all governmental purposes must be greatly decreased, and when that time comes it will be important to discriminate between those governmental functions which prevent injury and those which are for the public benefit. If it comes to a choice the latter should be sacrificed first.

There is another very important function of a State department of health which needs consideration, and that is its advisory power. This is a semi-judicial matter. Often the remedy for difficulties between contending parties is advice, not legal action. In all sorts of sanitary matters, in problems of water purification and sewage treatment, in matters of nuisances from offensive trades, a letter of advice from a State department of health which has established its reputation for fairness is often as effective as a legal order. In no way can State departments of health do more to improve sanitation than by improving the quality of their advice. Better advice and less drastic police action is, I believe, good policy; for more offenses against sanitation are due to ignorance of what to do than to willful disregard of law.

Akin to giving advice in particular matters is the setting up of standards of sanitation, of methods of procedure in all sorts of public-health activities. Any such standard should be carefully worked out, chiefly with reference to local conditions applicable within the State, but also with due regard to interstate and national relations. Standard rules and regulations are useful in two ways; they promote unity, and thus simplify administration; and they tend to raise the level of administration in communities hitherto backward up to that of the standard. Standards also carry with them two dangerous tendencies; they are liable to stifle progress by making people content with the standard, and they tend to destroy local initiative and self-confidence by causing cities and towns to fall back on the State. Standards tend to destroy initiative in those who make as well as in those who follow them. I believe that the standard methods of water analysis of the American Public Health Association have been highly serviceable in raising the level of water analysis in many laboratories; but I am also convinced that they have had a bad effect on the teaching of this branch of science, students and even instructors unconsciously getting the idea that the facile use of the standard methods represents the *summum* *bonum* of the art. In such a matter as plumbing regulations, uniformity throughout the State is desirable in the interest of convenience and economy; yet some municipalities prefer to make, as well as to enforce, their regulations, and it is difficult to decide whether in this matter uniformity is more important than local initiative. The special plumbing board appointed by the State Health Commissioner of Massachusetts is attempting to solve the problem by making certain minimum requirements State-wide and compulsory, and by setting up in addition standard detailed rules, which shall be optional for each city or town to adopt or modify. This seems to be a logical plan, as it means using the police power on a State-wide basis to prevent injury to health, and using only the advisory power in matters which relate chiefly to public benefit.

There is still another function of a State department of health which interlocks with all of the others, namely, that of inquiry, of investigation, of survey. Facts must be obtained as a basis of legislative action, judicial action, or advice, and the collection and preservation of these facts is of great importance not only to the department but to the community. The best method of preservation is by publication in annual reports. Interest in popular education in health matters has tended to turn the official reports of health departments into agents of propaganda. This is a mistake. Statistics make dry reading, but these records of facts should nevertheless form the backbone of annual reports. They are absolutely essential as a measure of progress. It is poor economy to eliminate them, because if not published they become unavailable in later years—and perhaps lost—thereby making new and expensive compilation necessary. Decisions as to what should appear in annual reports should not be left to officials who view the matter from the standpoint of printing and who have no expert knowledge of the value of the data presented for publication.

ENGINEERING DEPARTMENT.

The great shift of population from rural to urban conditions which has taken place in recent years has made the problems of public water supply and sewerage greater than ever before. The protection of water supplies against infection and the safeguarding of streams, lakes, and harbors against pollution involve engineering problems of a high order. These problems usually extend beyond municipal boundaries, and the State is the proper authority to cope with them. This is acknowledged by everybody, although it must not be forgotten that there are also interstate water pollution problems which must some day be taken up by the National Government or by river district commissions which override State lines.

A great question of administration arises in connection with these engineering matters. Ought they to be consigned to the State department of health, to the State engineer's department, if there is one, or to the water-supply commission, if there is one? Inland waters are used for public water supplies, drainage, power, recreation, fishing, and, in some instances, for irrigation and navigation. Conservation of all inland waters is of vital importance, and all of these uses must be given due consideration. It seems to me that the highest use of inland waters and the one which needs greatest consideration is that of public water supply. Drainage and water-power stand next, sometimes one, sometimes the other. The control of inland waters for water supply and drainage is an exercise of the police power in the interest of public health, and it seems to me that the control should be vested in that branch of the State government in which the police power is clearly recognized as a major function, namely, the State department of health. Water-supply commissions and State engineering departments are organized primarily to bring about public benefits, not to prevent damage being done. If the police power is exercised by them at all, it concerns safety rather than health. There is room, perhaps, for water-supply commissions in some States to appraise the water resources and to look after the uses of inland waters from the standpoint of public benefit; but to State departments of health should be given the oversight and care of the inland waters from the sanitary point of view, and this control should be recognized as paramount to all others. Hence, State boards of health need engineering departments. Most State boards of health have such departments to-day.

Besides water-supply and sewerage problems, there are other engineering matters which arise in connection with public health administration, such as problems of land drainage, of nuisances from trade waste, refuse disposal, plumbing, ventilation, rat-proofing of buildings, besides many minor engineering problems of rural sanitation. New York State has recently shifted its engineering department from the department of health to the State engineer's department. This is a regrettable action, as it takes away from the department charged with protecting the public health its strong right arm and reduces the engineering work involved in the sanitary protection of the waters to a subsidiary place in a department interested primarily in doing things for the public benefit and not acting under the police power. I hope that no other State will follow this unfortunate lapse from sound governmental principles which New York has made.

The supervision of water supplies and sewage-disposal works calls for chemical and biological as well as engineering work. These three sciences should be closely allied. Laboratory work is also required for other departments than that of engineering. The question arises, therefore, should the water and sewage laboratory be a part of the engineering department, or should all of the laboratory work be combined in a general laboratory in the interest of a unified equipment and of economical operation?

My experience in both the laboratory and administrative side has convinced me that there is little if anything, to be gained by consolidating laboratories in one department, although the physical concentration of the laboratories in one place may be a convenience and a slight economy. It is not often realized how widely and in what vital respects laboratories differ from each other. To be sure, gas and electricity and test tubes and balances are used in them all, but the work done in a laboratory of water analysis is as different from that done in a food and drug laboratory or a bacteriological diagnosis laboratory as the work of the electrical engineer is different from that of the sanitary engineer. The modern sanitary engineer, however, is trained to use the microscope and the balance as well as the transit and the level. To be of the greatest use to the sanitary engineering department the laboratory of water analysis should be a part of this department and separate in its personnel from all other laboratories. One reason for this is that more and more the importance of having water analysis conducted as field work rather than laboratory work is being appreciated. In the future the laboratories of sanitary engineering departments may be very largely headquarters for field parties who do their principal work in the field in connection with inspections. The laboratory as a tool should be always ready, quickly responsive, and the results should be available as soon as the analyses are completed. There should be no circumlocution in reporting, and the record files should be so kept as to be accessible at all times.

As to organization, my preference is for an engineering department in a State board of health, which has as its head a sanitary engineer who reports to the chief executive and who has under him an assistant engineer, a chemist, and a biologist, with such assistants for each as may be necessary. In a small department the chemical and biological work may be done by one man. In a large department one man specially trained in chemistry and another specially trained in biology are needed; but each should know the whole range of ordinary water analyses, chemical and biological, and each should be competent to act as director of the laboratory, this matter being governed by seniority. The special attainments in chemistry and biology are needed because of the unusual problems which are continually coming up for solution and in order that research may be carried on in the best way. While different forms of organization are to be expected in States which differ in size, condition, and tradition, one principle should always govern, and that is that the sanitary engineering department should have the engineering, chemical, and biological talent closely interlocked.

PERMITS, APPROVALS, ORDERS, ADVICE, AND RECOMMENDATIONS.

The object of the sanitary engineering department is to conduct such investigations and provide such information that the State board (or department) of health may act as may be necessary to maintain and improve the cleanliness of the environment of the people. The two subjects which loom largest in the work are public water supplies and sewerage systems, with their accompanying problems of stream pollution, sewage treatment, and water purification. It is right and proper that State departments should supervise these matters; but in considering what action should be taken the two ideas of police power and public benefit must be kept clearly in mind.

In employing the police power, practice has developed several methods which demand comment. One method is that of permit. The State law may prescribe that no sewer may be built to discharge into a strêam unless a permit has been received from the State department of health. This implies that there must be a subsequent inspection to make sure that the rule has been complied with. The object of the law is to prevent an injury. In plumbing, the system of permit and inspection is very common. The method is applied especially to matters in which the proscription is definite or of a routine character. It requires little special ability to carry out this method, as the rules are usually definite and infractions obvious.

Another method is that of approval. The State law may say that before works for a public water supply are constructed the plans must be approved by the State department of health. This action demands an investigation of the particular circumstances which exist. Approval is more than permission: it implies that the plan proposed will accomplish what is intended; that it is reasonably satisfactory. Those who exercise this power of approval should realize. however, that it is an act done under the police power, and that the object of police power is to prevent public injury, not to confer a benefit. While in common usage the word "approval" carries with it the idea of commendation, legally used in connection with the police power it does not commend. The approval of a plan really means that the plan is not disapproved; that it contains no serious fault; that it "gets by." The plan may not be the best plan, yet if it will reasonably serve its purpose of preventing a public injury to health, safety, morals, or the like, it may not be disapproved under the police power of the State. Approval may also carry with it the idea of necessity. For example, in Massachusetts the taking of land to protect a public water supply must be approved by the State department of public health, the idea being that the taking should not be made unless it is necessary for the protection of the public health. There may be other special cases of approval committed to the State department of health by the legislature, but what I am emphasizing here is the fundamental idea. In geometry we learned that certain procedures were "necessary and sufficient" to prove a given theorem. Those who have to approve sanitary engineering works would do well to keep these two words in mind.

Legal approval does not necessarily carry with it the idea of general commendation, and it is somewhat unfortunate that popular usage tends to make people read this idea into the word. The owner of some proprietary device, which has been approved for a special situation, likes to advertise his device by saying, "It has received the approval of the State board of health," and the public gets the idea that the board has given the device general commendation. For this reason letters of approval should be written with great care and with reference to possible misuse. In my opinion it is perfectly consistent for a State department of health to give approval to one plan and then proceed to advise a better one, or to reply to the applicant that approval to the plan will be given on a second request, but will be withheld pending the consideration of another suggested plan, which is deemed a better one.

We have next to consider the question of "orders" of the board of health. Here we recognize action under the police power in a drastic form. The State board of health orders that a certain thing be done in the interest of the public health. A city may be ordered to install a water purification plant or a sewage treatment works, or a manufacturer may be ordered to install devices for preventing the spread of nauseous fumes. It is necessary to be very careful in these matters not to exceed authority, not to be unjust, and not to be unduly arbitrary. It is sometimes difficult to discriminate between what is merely desirable and what is necessary. It must be remembered that the police power is not intended to bring to pass what is desirable—it is confined to what is necessary to prevent injury. Orders must be given with reference to the ability of their being carried out. There have been instances where a State board of health has ordered a municipality to install sewage treatment works, to do which would have involved borrowing money beyond the legal debt limit. Such an order is inconsistent with good government, to say the least, and is sure to raise legal complications.

Orders should be directed against the injurious result, placing the responsibility for the remedy upon the person or city causing the public injury. An order to cease committing a nuisance may be properly accompanied by advice as to how to stop the nuisance, but the latter must be regarded as advice only and there must be no implication that following the advice will relieve the wrongdoer of responsibility.

For example, it is a desirable thing for a city house to have a connection with the sewer in the street; but (unless there has been legislation to the contrary) the local board of health can not compel the house owner to make this sewer connection unless his method of disposing of the house sewage is in some way prejudicial to the public health, safety, morals, or the like. The responsibility is on the individual to abate the nuisance.

In the same way the treatment of the sewage of a city may be desirable on general sanitary principles, but (in the absence of definite legislation) the State can not compel the city to put in a disposal plant unless the existing method of disposal is doing, or is reasonably certain to do, a public injury. Even then the State should not attempt to order in detail the method of treatment, although it may order the nuisance to cease, and advise as to the best method.

In emergencies, of course, boards of health have, and ought to have, summary powers. They may have to act without legislation in the interest of preserving the health of the people. Such powers should be limited, however, to emergencies and should not be stretched too far. It is better that a community endure temporary injury than that the principles of good government be overruled.

With these conceptions of approval of plans and orders for abating nuisances, we see the important part which advice can and should play in sanitary administration. The benefits of advice depend upon the reputation which departments of health have for giving sound advice. Letters of advice should be brief, clear, and definite. They should be sent as soon as possible after the necessary information has been secured. This virtue of promptness has been sadly neglected in many States. Unless advice is backed up by reputation, it is likely not to be followed. This means that the sanitary engineer of a State should be competent, experienced, and trustworthy, a man of good judgment and abreast of the times in sanitary science. It means that his department must be well equipped to gather and preserve the necessary facts, and equipped to conduct such investigations and carry on such experimental work as may be required to give proper advice. As a result of my experience as a practicing engineer, as a public-health administrator, and as a historian of the Massachusetts State Board of Health, I am convinced that the advisory functions of a State department of health carry with them more power for bettering sanitary conditions than the more drastic actions covered by permits, approvals, and orders, although without the latter the advisory powers would lack force.

A recommendation is crystallized advice. It usually relates definitely to some policy or line of action. Unlike approval, a recommendation carries with it the idea of commendation.

I believe that there is a mistaken tendency in some States, and especially among some of the younger and less experienced officials, to exert too much authority, to try to accomplish results too quickly, to force communities to do things for benefit rather than to avoid injury, and to emphasize sanitation at the expense of other things just as important. Sanitation is not the *summum bonum* of life; it is a means to that end. If sanitation is forced much beyond the willingness of the community to support it, reaction is almost certain to follow. On the other hand, State health officials should avoid the opposite extreme very well illustrated by one of Hambone's Philosophical Meditations: "Parson tells me ah ort to be patient; but when ah tries to be patient, ah goes to sleep." State sanitary engineers must not sleep at their post—and I would like to add that I know of no class of men less likely to sleep at their posts than engineers.

THE SANITARY ENGINEER.

Finally we come to the sanitary engineer himself. Originally, and in its narrower sense, this term was applied to engineers who had to do with sewers and drains. Plumbers still style themselves sanitary engineers and have a national association of that name. But the field has expanded and now includes not only sewers, but sewage treatment, water purification, and the like. It embraces other cleansing operations such as street cleaning and refuse disposal. The sanitary engineer of to-day must have a knowledge of biology and chemistry as well as hydraulics and the art of building; he must be familiar with laboratory procedures; he must understand the relation between sanitary works and the public health and between the cost of works and sanitary value. It has been suggested that such a man should be called a public health engineer. This is certainly an appropriate title for engineers in a public health department; nevertheless, it is merely a translation of sanitary engineer, and it does not seem to be worth while to multiply names and titles without adequate reason. In fact, I sometimes think it would be just as well if sanitary engineers were known merely as civil engineers, or even as engineers, just as public health officers are known as doctors. Personally I should regard the title of "Engineer Smith" as equal in honor, dignity, and importance to that of "Doctor Smith," assuming of course that the title "Engineer" represents an engineering degree, membership in a national professional society, or some other adequate standard of attainment.

From my experience, I believe that in a State health department the work of the sanitary engineer is of importance equal to that of the doctor of medicine. I can say this with perfect frankness, because no one has been more earnest than I have been in teaching biology to engineers, in securing cooperation between engineers and doctors in public health work, and in establishing schools of public health in which hygiene, preventive medicine, engineering, statistics, and administration shall be properly blended. In health department organizations engineers and physicians should be given equal standing, equal salaries, and equal ratings as to seniority, bearing in mind certain differences between administrative and executive work. The United States Government, through its Public Health Service and the Medical Departments of the Army and Navy, would do well to set an example in this matter. The lack of recognition of equality is one of the reasons why some of our best young engineers hesitate to enter the Public Health Service to-day.

I believe that the executive positions in health departments should be under the civil service (perhaps I ought to say under a reformed civil service), and that there should be provision for retirement on pension at a certain age or after so many years of service. In consideration of this feature, the salaries paid should be somewhat lower than those paid for work of similar grade in private practice. Just as business men make more money but take greater risks, so engineers in private practice should make larger incomes while subjecting themselves more to the ups and downs of business conditions.

The great bugbear of public positions to-day is political interference. This is steadily causing a depreciation in the character of engineering service in cities and States alike. Civil service has not been an unqualified success. It has tended to keep out the unfit, but it has not increased the excellence of the service. It has made it difficult to get rid of men who are lazy, of mediocre ability, or of unpleasing personality, and pleasing personality is a quality very essential to teamwork in a public department. Reform in civil service is highly essential, if our health departments are to be placed on a high plane. There is another angle to the matter. If it is not right for legislators to interfere with the personnel of the executive departments, it is equally bad for the latter to interfere with legislative matters. Unfortunately, there are too many examples of this practice.

More than all else it is important that engineers pay greater attention to their own ability. The young graduate of an engineering school is a fledgling; he can fly a little, but not far or well. He needs practice; he needs contact with engineering problems; he needs much study. The engineer must study throughout his life. Self-made engineers, like the engineers of the past, developed habits of study which never left them. College graduates too often think that their studies are over when they are graduated. When an engineer retires for age he may cease studying, but not until then. William Mulholland, the self-made engineer who built the great Los Angeles Aqueduct, told me recently that he takes 15 magazines and reads them. Sanitary engineers must read much, because their field is wide and embraces many sciences.

In States where appropriations are limited, the attempt to get proper men for the position of sanitary engineer is met in various ways. One way is to employ an engineer on half time, allowing him to engage in private practice. This I believe to be a thoroughly iniquitous arrangement, unless the engineer conscientiously refuses to do any private work whatsoever within the limits of the State. Even then the arrangement is not altogether satisfactory, because it is difficult for the engineer to be on hand at the right time. Another method is to employ an engineer on half time, letting him combine State work with teaching. This is less objectionable, but not altogether satisfactory. A full-time sanitary engineer is as much needed as a full-time health officer. The job is big enough for a whole man and for the best man obtainable. In my opinion, it is better to obtain a lower priced full-time man than a higher priced half-time man. The appointee then has a definite piece of work for which he is personally responsible. This responsibility tends to make him do his best; whereas if he is carrying on two jobs at the same time, there is danger that he may slight both of them, unless he is a man of exceptional ability and force of character.

Even if a sanitary engineer gives what is practically his whole time to a State department of health, he should not allow himself to engage in private practice within the State, for sooner or later he is sure to find himself in a situation which will seriously compromise his reputation. He may, however, accept occasional consulting engagements outside of the State without overstepping the limits of professional etiquette. Professional ethics among engineers is something to be cultivated and guarded with jealous care. Licensing of engineers by the State or the setting up of any artificial standards will never accomplish for the profession what the engineers can do for themselves if they will.

There seems to be one solution of this problem which nowadays is seldom tried, namely, to reinforce the official sanitary engineer with a consulting engineer who is either regularly retained or called upon for advice in particular cases. The Massachusetts State Board of Health had this practice at one time, and some of our most eminent engineers, chemists, and biologists have served the State in a consulting capacity. This practice, in my opinion, should be renewed and extended. It would have several advantages. In the first place, it would greatly strengthen the reputation of the State department of health and give its letters of advice greater weight. It would make it possible for the smaller States to have as good advice as the larger States. In case of controversies it would strengthen the State in its contentions. It would tend to soften one of the sharp corners which result from laws requiring plans to be approved. At the present time it so happens that many of the engineers engaged in private practice are older and more competent than the State engineer who must pass upon the plans submitted. The less experienced State engineer may, however, understand local conditions better than the designing engineer who has made the plans. Under these conditions, refusal to approve the plans creates a situation disagreeable to both parties. If, however, the State department of health had a consulting engineer, doubtful plans could be approved or disapproved with better grace and a greater feeling of security that the proper result had been reached.

There is also a present-day tendency for engineers in high positions to do too much work by proxy. Accustomed to assistants, they have stenographers to write their letters and young engineers to make their computations. Many of our modern methods, thought to be so efficient, are not so, because they are turning our chief engineers into routine executives and are confusing administrative and executive work. Our chief engineers and consulting engineers ought to do more personal engineering work and leave more of the routine work to others. Engineers who cease to make personal studies run downhill rapidly.

Engineers who enter the public service under present conditions do so at a personal sacrifice. I believe that public service ought to involve personal sacrifice. Young men entering the service should understand this clearly. The sacrifice is recognized in times of war; it should be recognized in times of peace. Public service means doing for others. It is only by the recognition of this principle that our health departments will be filled with the right kind of men—men who are not there for gain, for large salaries, or easy work. Personally I know of no better way for a young man to serve his day and generation than to become an engineer, learn how to employ the great forces of nature for the use and convenience of man, and then enter the public service and spend his life for the public good. It does not mean wealth; it means hard work and many conflicts with the powers of evil. It may not always mean public recognition and honor; but it does mean much personal satisfaction and many pleasures by the way.

Mr. Sol Pincus presented the following report:

REPORT OF THE COMMITTEE ON CROSS CONNECTIONS, BY-PASSES, AND EMERGENCY INTAKES ON PUBLIC WATER SUPPLIES.

It must be recognized to-day that the problem of having safe water furnished for human consumption in cities in this country is now very generally, and almost entirely for the larger cities, a problem of protecting and insuring the freedom from contamination of the existing water supplies which are ordinarily found to be safe, and not so much the problem of making original installations or reconstructing water-supply plants. The water-supply question for American cities, taken as a whole, is reaching a new phase of development, as far as the assurance of the safety and health of the consumers is concerned; a phase where the regular protection and maintenance of the present standards of quality and safety are the foremost matters of concern.

The typhoid fever death rate of American cities has been steadily diminishing, so that to-day it is fully a tenth of what it was a generation ago. The average for the last few years for the larger cities of the country is not far from five per hundred thousand, which is a result largely attributable to improved water supplies. Entire States are now turning in typhoid death rates year after year below eight per hundred thousand, and in some few cases below five. For the State health department, where the general responsibility for the maintenance of such diminishing typhoid mortality rests, there is a most difficult challenge to be faced in insuring that the public water supplies will be so thoroughly safeguarded and the remotest possibility of infection of the supplies removed that the decline in typhoid fever deaths will not be halted or reversed. While some cities or sections of cities were being furnished with unsafe and contaminated water, there was always the certainty of progress to be achieved in the reduction of the typhoid fever rate by the improvement each year in one or more cities of the quality of the public water supply. Such reductions would oftentimes result even though there might occur a breakdown in an improved water supply. But as the case and death rate curves come lower and lower with passing years, a point will be reached where a single outbreak, even of a relatively small number of cases, will have a predominating and controlling effect on the State rate for the year. Such a point is fast being approached by many States, if it has not already been reached by certain few States. And with the approach of this condition, the proverb, "Eternal vigilance is the price of freedom," must become the ever-present guiding principle of control if freedom from water-borne disease is to be maintained. The supervision that is to maintain this almost complete freedom from the possibility of the infection of the water supply requires the steady, watchful, and thorough direction of a conservative and critical yet open-minded sanitarian, whose familiarity with the many-sided ways of possible water-supply contamination has not bred a contempt for the minor paths by which dangerous conditions can arise in the water supply.

In view of the present circumstances regarding the problem of the water supplies of most large American cities, where the public water supply is ordinarily good, it was felt by the members of the committee that increasingly greater consideration will have to be given to by-passes, emergency intakes, and the numerous cross connections which are frequently present. Attention to the use of these devices may soon have as great a significance in real disease reduction as will the improvement of the ordinary quality of water supplies. In the maintenance of safe public water supplies, there are no matters requiring more careful attention and capable of more baneful consequences than these, excepting only the daily operation of the purification processes.

The uncontrolled and unregulated use of cross connections, by-passes, and emergency intakes on water supplies seems to have been quite general until the last few years. Before 1910, little notice was taken of the presence and use of these devices, according to the State health reports of the States most active in water supply supervision. To-day, even in the majority of the States, the matter of the proper supervision and policy governing these devices, especially cross connections, is amazingly undeveloped and unformulated. Even the definite presence of cross connections, by-passes, and emergency intakes is generally unknown to the States or local departments. Such a situation is potent with most serious ill-consequences to the citizens of those places where investigations have not been made for determining the prevailing conditions regarding such devices and where the proper supervision has not been established.

It appears that the question of by-passes on public water supplies was the first of these devices regarding which action was taken by any of the States. As the satisfactory operation of water purification processes became more and more definitely achievable, it soon was obvious that by the existence of by-passes around any salient part of the purification scheme the value and reliability of the entire process was seriously vitiated. Through the power and authority to review and approve plans for new construction on water supply plants, the better equipped States have definitely shown their disapproval to all such by-passes and have required their elimination, at least from any plans for proposed water supply plants. There seemed to be no doubt in the minds of the members of the committee that all by-passes should be removed from water purification processes, except by-passes about primary sedimentation basins, aerators or mixing chambers. The basis for exempting by-passes around these features of the purification process was on the ground that in some installations these features were not a necessary step at all times in the purification process, nor were they of great sanitary significance at all times. The committee is of the opinion that there can scarcely be any objections to this principle and the exemptions specified.

The question regarding the most advisable State ruling on the installation of emergency intakes on public water supplies has been in some ways one of the most difficult and perplexing problems before the State health departments. The danger to the public health from the existence of such an intake whereby unsafe water could be sent into the public mains has been universally recognized. However, in frequent instances it was contended that compromise with the demands of full safety was necessary and that such intakes should be permitted on account of otherwise large fire hazards. In the very large cities, it was claimed that the risk of being without adequate quantity of water at any time overbalanced the health hazard. Both as sanitary engineers and as officials with a public responsibility, the committee could not acknowledge in principle the validity of these contentions. Though in some cases for a long time it may not be economically justifiable for a town or city to incur the indebtedness necessary to provide such an enlarged water supply installation as will make the emergency intake unnecessary, it is, however, asserted that no city can build for permanency in the present era if the health of all its citizens is endangered by the unguarded and ever present possibility of the infection of its public water supply. It is from that point of view that the committee has adopted the very positive principle on emergency intakes, that no emergency intake should be established or maintained in connection with a public water-supply system, a stand which has already been enforced by some of the States. The committee, however, has recognized that a modification of the principle may be necessary for present enforcement in the case of cities with inadequate water supplies, but such qualified enforcement has been considered only as a temporary measure.

The committee gave the greatest part of its discussions to the recommendation covering the question of cross connections on public water supplies. as this problem has been so prominently and urgently placed before the waterworks and public health officials in many of the States. Wide difference of opinion was found to prevail among the various States in what should be considered the proper policy for regulating cross connections. This divergence of view point was well represented on the committee, and it was only after very extended discussion, both personal and by correspondence, that an agreement was reached on this subject.

The cases of the use of cross connections were divided into two kinds. For the first group, the committee came to definite and prompt agreement, namely, that when an impure independent supply was maintained for ordinary industrial purposes. any cross connection with a public supply regradless of the devices that may be installed or the precautions that may be taken, would be an unsafe and altogether too dangerous procedure at any time.

For the second group, where a cross connection to a private fire protection system using impure water exists, but where no outlet of water is provided except through fire hydrant, sprinkler plug, or hose connection, a somewhat less hazardous situation was recognized. Though the demands for complete safety require that the water served for human consumption must at all times be free from danger and hence connection with impure supplies totally disapproved, the committee came to the opinion that account must be taken of the temporary use in some circumstances of cross connections with the most effectual safeguards possible. It was believed that such temporary permission by the State department of health in exceptional instances for the use of a cross connection for a fire protection service should never become a permanent provision, but after a sufficient period for the development of the public supply for adequate fire protection the permission would be revoked. An instance of such a course is evidenced by the city of Hartford. Here in 1909 some of the first installations of cross connections with factory mutual double check valves were made. After 10 years had elapsed an order was issued in 1920 giving the mills until September of this year, 1921, to completely sever all physical connections.[1] The committee has been convinced by the large number of instances of the contamination of the public supply through cross connections that such connections as a permanent measure should never be indorsed. The committee wishes especially to call attention to the many cases of pollution from such connections that are cited in Appendix No.

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[1] The manager and chief engineer, Mr. C. M. Saville, of the Hartford water department, expressed his conviction as follows: "In the 10 years' experience of Hartford with 12 sets of check valves, the records show that eternal vigilance only can keep these valves even passably tight; that they do leak on the slightest provocation; that sometimes both valves have been found leaking at the same time; and that there is no assurance that they will remain tight even for a short period after test. The custom of inspection is a visit once each week to make pressure tests and once every four months for a thorough inspection of the entire valve." (Journal of American Public Health Association, September, 1920.)

4 to the final report on private fire protection service printed in the November, 1920, Journal of the American Water Works Association, and to those cited in the annual reports of the New York State Department of Health.

As regards the increased fire hazard from the elimination of cross connections, it is believed after the provision of what is generally accepted as adequate public fire protection service, as to quantity, pressure, and distribution, that no life hazard from fire can be justly charged to the public water supply system. In the instances where the loss of human lives occurred at fires, which are given as arguments for permanent cross connections, it has been found upon investigation that were adequate public water supplies available in all probability the loss of life would not have been prevented by the use of cross connections, but the deaths were due to flagrant violations of fundamental building principles regarding fire escapes, outlet doors, floors, wall thickness, fire-fighting equipment, etc.

DATA OBTAINED FROM QUESTIONNAIRE.

The number of States replying to the questionnaire were 30. Of these States only 15 could give positive figures on the number of public water supplies having by-passes, emergency intakes, or cross connections. Two States reported no cross connections, while several reported two or three, and three States reported 18 or more water supplies with cross connections. One State reported no by-pass existed on any public water supply, while most of the States giving definite figures showed only a few water supplies, less than 10, which had by-passes. There was no State that reported a total absence of emergency intakes on the public water supplies, but five States each reported one emergency intake.

Regarding the regulation of cross connections there were three States which specifically regulated against any cross connection between a public and an unsafe water supply. Most of the States reporting attempt to control cross connections as well as by-passes and emergency intakes through the general State health department authority and through the power to review and reject plans for new installations and additions to water-supply plants.

Of the 30 States from which replies were received, 13 stated that any type of cross connection was opposed and would be disapproved. This number included the three States having a specific regulation against the maintenance of a cross connection. Nine States approved or permitted the use of cross connections when proper safeguards are provided. One State doubted the advisability of permitting the use of any cross connection, while another State did not approve any but believed the complete elimination of cross connections could not be enforced. Six States that replied gave no opinion in approval or disapproval regarding cross connections. It is a surprising thing that many of the nine States permitting or approving cross connections seemed to make no distinction in their policy between a cross connection joining the public water supply and a system for fire protection only, and a connection joining the public water supply to an unsafe private or industrial water supply.

Eleven States gave accounts of a total of 20 outbreaks of typhoid fever, dysentery, or gastro-enteritis, 11 of which were caused by cross connections, 4 due to by-passes, and 5 due to the use of emergency intakes. These reported examples of disease outbreaks known to have been caused by use of cross connections, by-passes, or emergency intakes are very largely incomplete, as numbers of instances of such outbreaks other than reported by the questionnaire replies are known to the committee members. In some of the reported outbreaks due to cross connections, a single check valve, in addition to a gate valve, had been provided. Only one instance was given where leakage had been detected through two check valves at the same time.

The complete replies to a previous questionnaire (regarding only cross connections) which had been circulated in 1918 were made available to the committee, and it is believed that the summary of the replies obtained then is worthy of present consideration. Thirty-three States and one Canadian Province sent replies to the questionnaire concerning the existence of specific regulations with respect to cross connections and the State's attitude regarding the use of such connections with double check valves. Replies to a similar questionnaire were also received from 10 of the largest American cities.

There were two States that had specific legislation regarding cross connections at that time, one permitting their installation under certain safeguards and the other requiring a notice to the public whenever a cross connection is used. Thirty-one States and one Province had no specific law or regulation relating to the installation or use of cross connections. Eighteen States approved or permitted a cross connection to be installed and maintained under certain provisions, while 12 States and one Province did not approve or permit, as far as possible, any cross connection whatever. Three States gave no definite or clear opinion.

The replies from the 10 large cities are especially noteworthy, for although only three had specific regulations or ordinances against the use of cross connections, they were all emphatically opposed and unanimously refused to permit any cross connection whatever with their public water supply.

CONCLUSIONS OF THE COMMITTEE ON CROSS CONNECTIONS, BY-PASSES, AND EMERGENCY INTAKES ON PUBLIC WATER SUPPLIES.

The committee on cross connections, by-passes, and emergency intakes on public water supplies, after several meetings and full consideration, recommends the adoption of the following definitions and principles:

A. CROSS CONNECTIONS.

Definition. A *cross connection* is a physical arrangement whereby a public water supply system is connected with another water supply system, either public or private, in such a manner that a flow of water into such public water supply system from such other water supply system is possible.

Principle No. 1. No *cross connections* should be established or maintained between the public water supply system and any other water supply system, private or public, unless both water supplies are of safe sanitary quality and both supplies and the connection thereof have received the approval of the State health department.

Principle No. 2. In cases where it is necessary or advisable to supplement an impure private water supply with the public water supply distributed in the same piping system, the public supply must be made available by delivering it into a cistern suction well or elevated tank, at an elevation above the high water line of such cistern, suction well, or tank.

RECOMMENDED MODIFICATIONS OF ABOVE PRINCIPLES FOR TEMPORARY APPLICATION UNDER EXCEPTIONAL CIRCUMSTANCES.

While the committee is of the opinion that full safety demands such complete separation of the public water supply system from other water supply systems delivering impure water, the committee recognizes the relative degree of safety which can be provided by suitable check valve installations on connections between a public water supply and a piping system used for fire protection only.

The committee is cognizant of the fact that such connections may be proper and reasonable under certain conditions, and desires to express the following requirements which should be met in making and maintaining such installations:

1. Such connections should not be permitted where the available public water supply or private fire protection supply is adequate for fire protection purposes.

2. That the fire protection piping system shall not be connected with any other piping system upon or within the property served, and that there shall be no outlet from such fire protection piping system except through sprinkler head, fire plugs, and hose connections. This requirement is intended to prevent a flow through check valves, except at times when a sprinkler head, fire plug, or hose connection is open.

3. The cross-connection shall be equipped with such devices as can most effectually prevent an inflow of water from the fire protection system to the public water supply system.

4. The committee is of the opinion that the most efficient and dependable device developed up to date (aside from the method described in principle No. 2 above) is the check valve installation recommended by the associated factory mutual fire insurance companies of Boston, Mass., consisting of two gate valves with indicator posts, two check valves of the factory mutual type, with drip cocks and gauges for testing, an alarm valve equipped with a recording pressure gauge, a by-pass meter around the alarm valve, all to be placed in a vault of water-tight constructions accessible to ready inspection.

5. A systematic test inspection of the cross connection, including periodic examination of the interior of the check valves by the department in charge of the public water-supply system, must be provided, without which inspections the installations of the cross connection would be a highly dangerous health menace. The inspection must therefore be made reliable, thorough, and responsible.

6. The committee views as a self-evident requirement that in every case where a cross connection is being considered for approval a thorough investigation will be made as to local conditions and as to the necessity and advisability of the cross connection, and that the local municipal officials will be made fully acquainted with the circumstances and given due opportunity for presenting their views.

B. BY-PASSES.

Definition: A *by-pass* is a physical arrangement whereby water may be diverted around any feature of a purification process of a public water supply.

Principle No. 1. No *by-pass* should be established or maintained whereby water may be diverted around any feature of a purification process of a public water-supply system, provided that with the specific approval of the State department of health *by-passes* may be permitted around primary sedimentation basins, aerators, or mixing chambers.

APPLICATION RECOMMENDED.

Where there are existing by-passes, except as provided above, the correction should be obtained by the complete removal of the by-passes or the removal of a section of the by-pass piping.

C. EMERGENCY INTAKES.

Definition: An *emergency intake* is an intake or other device capable of introducing water into the public water-supply system from a source of supply which, because of its unsafe characteristics, has not been approved for ordinary use by the State department of health.

Principle No. 1. No *emergency intake* should be established or maintained in connection with a public water-supply system.

APPLICATION RECOMMENDED.

Where emergency intakes are existing and where the regular water supply is adequate and the emergency intake can be safely removed, the emergency intake should be completely taken out so as to be unavailable for use.

Where the regular water-supply system is not adequate and the maintenance of an emergency intake is conclusively necessary, it is obvious that such intakes must be continued, but should be under the complete supervision of the State department of health, so that the intakes will not be used except under conditions constituting an emergency. During the continuance of the emergency intake, the State department of health should make every effort to obtain the enlargement of the existing water supply plant, so that the emergency intake may be removed at the earliest possible time.

For the maintenance of an emergency intake, under the above-mentioned circumstances, the following safeguards should be adopted and enforced:

1. (*a*) The water-tightness of the valve on the emergency intake connection should be tested and the valve sealed by the State department of health or (*b*) the valve should be sealed and a section of the intake piping should be removed, making it necessary to replace the pipe section before the intake is available.

2. Provision must be made for the chlorination of any water taken through the emergency intake before delivery is possible to the distribution system.

3. Whenever it becomes necessary to open the emergency intake, the waterworks official must give immediate notice, if at all possible, preliminary to the opening of the intake, to the public affected and to the State and local health officials. The disinfection equipment should be placed in service immediately, and a warning given to boil all water used for drinking and domestic purposes. Such warning should be continued until the emergency intake is again closed and sealed, and the water supply system cleansed and declared safe by the State health department.

A motion was made by Mr. J. F. Jackson, Connecticut, seconded by Mr. E. S. Tisdale, West Virginia, to have the report adopted and printed as the action of the conference, and copies sent to the various State sanitary engineering divisions and to the fire underwriters associations. The motion was adopted.

Mr. J. I. Connolly presented the following paper:

EPIDEMICS FROM STEAMBOAT WATER SUPPLIES.

A public health problem that has thus far remained unsolved, even though it is ofttimes of very great importance, is the prevention of epidemics of disease caused by unsafe water supplies on vessels. Numerous epidemics in the past have been attributed by common opinion to such causes, and a few have been carefully investigated and the source of the infection proven to be the use, for drinking purposes, of contaminated water supplies on shipboard.

The continued existence of these dangers to the public health is both a disgrace to our civilization and a challenge to our health authorities, both State and National, to strike at the root of the evil and forever eradicate it. Such a task is not one to be lightly essayed, in view of the many difficulties to be surmounted. The seriousness of the problem is more apparent when we consider the large proportion of cases among those who might be exposed, compared with most epidemics of water-borne diseases from other sources. In a number of instances, particularly those where epidemics originated from the use of contaminated drinking water on excursion steamers, as many as 60 per cent of all the passengers were made ill. When the passengers are changed every day or so the large number that may be exposed can scarcely be realized.

Thus, for instance, a serious epidemic was traced last year to an excursion steamer on the Mississippi River, which carried 98,000 passengers during the four or five summer months that it was in operation. Another excursion steamer, to which another equally serious epidemic was traced in the summer of 1920, is operated the year around, traveling the whole length of the Mississippi from St. Paul, Minn., in the summer time, to New Orleans in the winter, and carries in the neighborhood of 200,000 passengers during the year. It is estimated that 16,000,000 passengers are carried annually on the Great Lakes vessels alone, of which about 9,000,000 are ferry passengers who use no drinking water.

But the ill effects are not confined simply to the large numbers infected on the boats, for the germs are carried in the bodies of the victims the whole length and breadth of this great land, to start innumerable new foci of infection wherever they may go. Therefore the problem is one which interests not only the cities and States on the waterways, which naturally feel the most severe and immediate result of such epidemics, but also every city, town, and village to which a traveler might come, bearing in his body the seeds of disease, poverty, and death.

The magnitude of the problem consists, not alone in the number of vessels and passengers concerned and the extent to which the effects of epidemics may ramify to the farthest corner of our country, but also in the difficulty experienced in securing the substitution of safe water supplies for the dangerous ones responsible for these epidemics. The fact that the boats are sailing upon water makes the temptation to procure drinking water from directly overboard through the sea cocks of the vessel one not always easy to resist. The surprising ignorance and almost criminal apathy in regard to sanitary requirements displayed by the crews of vessels is often the cause of trouble, as this indifference leads to the misuse or the failure to use the safeguards for the water supply that may be provided. It may sound unbelievable to those accustomed to dealing in sanitary matters, but I can assure you that the engineer having charge of the purification of Mississippi River water for drinking purposes on one of the vessels causing epidemics last year told me that water purified itself naturally in flowing a distance of 60 feet, so that untreated river water taken 60 feet below a sewer outlet was perfectly safe to drink, and that he himself always drank untreated river water. Certainly the water he was furnishing to the passengers showed that he was putting his theories regarding the uselessness of purification into practice. When he started working on the river, he had had various stomach and intestinal disorders, he admitted upon further questioning, but he didn't attach any significance to them in connection with the drinking water.

Where water is taken from the river or lake upon which the ship plies, no words can be too strong in condemnation of the use of such a man to oversee its purification. Even when there is employed as engineer of the vessel a man who is properly trained in water purification and who realizes the responsibility devolving upon him in regard to it, when an emergency arises his first care in practically all cases will undoubtedly be for his engines, and the water treatment will receive but scant attention. Therefore it is important to secure for ships, using such water supplies, some form of purification apparatus that will be automatic and foolproof in its operation, so as to give a safe water at all times with a minimum of attention.

Nor are these the only considerations, for the question of the initial cost of treatment apparatus, the cost of operating it, and the difficulty of always providing sufficient quantity without having recourse to contaminated sources are sometimes important. Not dismayed by the enormity of the problems involved, however, the various State departments of health and the United States Public

Health Service, cooperating with each other, are now taking practical and energetic steps toward removing this danger. That the sanitary authorities are not making a mountain out of a molehill, nor seeking to interfere where intervention is not necessary, I propose to show by a brief consideration of a few epidemics traced by competent investigators to the use of contaminated water supplies on shipboard.

In the last dozen years, more and more attention has been given to these matters. In 1909 Surg. J. O. Cobb, of the United States Public Health Service, in the Journal of the American Medical Association, called attention to the high typhoid rates among sailors and to the contamination of their drinking water as its cause. In the second report of the Lake Michigan Water Commission, Surg. G. H. Young, of the United States Public Health Service, reported an investigation of typhoid-fever rates among crews of Great Lakes vessels, attributing the high rates to contamination of water. The fact was brought out that water of the Great Lakes, which was used untreated, caused a higher typhoid rate on these steamers than existed on river or coastwise vessels, where the water had to be filtered or taken from a supply on shore.

One of the earliest epidemics resulting from using contaminated drinking water aboard ships to attract widespread attention occurred in 1907, when, during one short period of a summer cruise of a Great Lakes vessel, 77 cases of typhoid fever developed from this cause.

In July and August of 1912 an outbreak of gastrointestinal disturbances and of typhoid fever occurred at Clinton, Iowa, and in the neighboring cities of Davenport, and Sabula, Iowa, and Albany, Savanna, and Quincy, Ill. This epidemic was carefully investigated by Surg. L. L. Lumsden, of the United States Public Health Service, and Dr. H. R. Sugg, the health officer of Clinton.

Their studies showed conclusively that the outbreak was caused by infection contracted from some source during an excursion on the Mississippi River on July 29, 1912, abroad the steamer *G. W. Hill.* There were 1,550 passengers from the cities and towns named on the excursion, some of whom took their own lunches and beverages with them. Others ate and drank at various restaurants and lunch rooms in Davenport, but no large proportion ate or drank at any one place. Eight hundred, or approximately one-half the passengers, became ill after their return from the trip, however, and four died, so attention was directed to things consumed on the boat. By tracing the movements of the victims and others, and ascertaining what and where they ate and drank, it was shown that those who had gone to Davenport but did not return on the boat were not made sick, while all the victims who were interviewed in the course of the investigation gave a history of drinking water during the return trip from Davenport on the boat and none of those who drank no water aboard were taken sick.

Attention being thus directed to the drinking water, it was found that it had been much more turbid just as the steamer left Davenport than it had been before reaching that city. Furthermore, two passengers saw a deck hand manipulating the valves of the water storage tank on the upper deck, and one, who was seated against this tank, heard water running into it, all while the steamer was lying at Davenport, at the foot of Brady Street, in such a position that the water intake must have been within 20 feet of the outlet of the Brady Street sewer. Upstream from this spot several other sewers also discharged within a short distance.

The investigation cleared of suspicion all of the foods and beverages taken aboard the steamer by the excursionists, the sandwiches, ice cream, and drinks sold aboard the steamer, and the ice used for cooling the water, and fixed the responsibility for the outbreak upon the drinking water obtained thus at Davenport in close proximity to the sewer outfalls.

The apparatus for supplying the water on the boat consisted of a piping system and a Lynn stone filter, but, according to the statements made by passengers that the water from the pipes sometimes contained small twigs and bits of trash that couldn't possibly have passed through the pores of the filter, the water was either by-passed around the filter, or the filter stone was broken, permitting unfiltered water to be delivered by it.

In September, 1913, a party of 300 people chartered the steamer *Rochester* on Lake Erie for a trip from Buffalo to Put in Bay and Detroit and return, to attend the Perry Centennial Celebration. Another party, 122 in number, on the steamer *Greyhound*, followed the same itinerary and attended the same meetings at the same times.

Out of the 235 of the 300 members of the *Rochester* party, from whom reports were secured, there were 122 cases of gastroenteritis, 42 of typhoid, and five deaths. The *Greyhound* party furnished a valuable control in investigating this epidemic, since only 14 light cases of diarrhea occurred during and after the trip.

Careful inquiry on all points, made by Passed Asst. Surg. Hugh de Valin, of the United States Public Health Service, showed no probability of the causative infection having been acquired on shore at any of the places visited. During the entire season there had been more or less persistent diarrhea among the crew of the *Rochester*, together with four cases of typhoid fever, one of whom died. Inquiry into the times of taking in water for drinking purposes aboard the *Rochester* revealed the fact that twice during the trip water was taken, without purification, from very dangerous and highly polluted sources, one not far below the Detroit sewers. and on several other occasions from places where the water was sufficiently contaminated to be unsafe.

All data pointed to the water supply used aboard the *Rochester* as being responsible for both the crew's illness and for the extensive epidemic among the passengers. It is possible that the direct mode of transmission was by one of the crew, himself made ill by the water, passing the germs on to the passengers through the medium of food, yet the highly polluted water, used at least some of the time by these people while on the ship, was undoubtedly directly responsible for part of their illness.

In August, 1913, the U. S. S. *Gopher*, assigned to the State of Minnesota for use as a naval training ship, took on a company of naval militiamen and made a cruise in Lakes Michigan and Superior. Of the men aboard, 102 were from Duluth and 41 were from Pine City, Minn. During the cruise, and commencing about five days after starting, 60 per cent of the whole ship's company suffered from gastrointestinal disturbances, and three cases of typhoid developed in the Pine City detachment. A larger percentage of the men from Pine City were affected than of those from Duluth. The Pine City men were for the most part newly enlisted, whereas the majority of the Duluth men had been on similar cruises before and had become more or less immune.

Careful inquiry was made by Passed Asst. Surg. Hugh de Valin and the Minnesota State Board of Health relative to the food, milk, water, etc., used ashore at the various ports visited. No large proportion ate or drank at any one place ashore, so, as the character of the outbreak pointed to a common source of infection, the trouble was sought aboard ship. No outbreaks of similar diseases had occurred in any of the places called at by the ship nor in the home cities of the men.

The food, milk, and ice used aboard the *Gopher* were investigated and found to be pure, and other people using these same products were not subjected to such outbreaks. Search was made for a possible typhoid carrier among the crew, but none was found. By a process of elimination all possible sources of infection were disposed of except the water supply. This was found to have been taken untreated from the two lakes through the same pipe line and pumping system that was used for washing down the decks, often in grossly polluted harbors. Water for washing purposes in the toilets did not come from the storage tanks, but was continuously pumped from directly overboard, even when in harbor. The dangers of this practice are shown by the fact that several admitted having drunk water from the faucets supplying water intended solely for washing.

Water was taken into the storage tanks in several grossly polluted places, notably between Chicago and Milwaukee, near shore, where the sewage of Racine, Kenosha, Milwaukee, and other cities is discharged directly into the lake, and also 4 miles from Two Harbors, Minn. The men remarked about the difference in the appearance of the water as they passed from Lake Michigan into Lake Superior. As a result of the investigation the responsibility was fixed upon the water supply as the cause of the epidemic.

That the action of the engineer of this vessel in taking in water near polluted harbors is not an isolated instance is evidenced by the fact that a severe epidemic among the crew of another vessel was caused by taking in water when only 5 miles from Two Harbors during the same year.

Another epidemic of large proportions occurred the same month that the outbreak on the *Gopher* took place. The *Huron*, plying between Cleveland, Ohio, and Sault Ste. Marie, Mich., was involved in an epidemic wherein 150 passengers, or about 50 per cent of the total number aboard, were made sick. Most of the illness was in the nature of gastro enteritis, but there were seven typhoid cases and one death resulting from the outbreak. The ship started from Cleveland, took on unpurified water in the western end of Lake Erie, where the contamination of the water by the sewage of Detroit and other cities makes this a dangerous practice, then passed up the river and took water at various places in Lake St. Clair and Lake Huron. Curiously, the passengers who boarded the ship at the points first touched and made the round trip were about the only ones affected, as very few of those who came aboard at the various Canadian stops on the return trip from Sault Ste. Marie were made sick.

The outbreak clearly had a common source, and since the passengers came from widely separated points by various routes and no similar epidemics existed at the starting point nor at any of the points touched en route, it was evidently due to something on the ship. The only place, other than on shipboard, that could have been a common source of infection was the hotel in Sault Ste. Marie where all had dinner, but this was ruled out by the fact that the epidemic was in full swing before they reached this city.

Consequently the food, milk, ice, and water used on the ship were investigated by Passed Asst. Surg. Hugh de Valin and Asst. Surg. Joseph Bolton, of the United States Public Health Service. As a result of their efforts, the responsibility was again fixed upon the drinking water supply. It was found that no record was kept of the times when the drinking water tanks were filled and that they might be filled anywhere; also that water for washing in the toilet rooms was pumped continuously, in grossly polluted harbors as well as in the middle of the lakes, through the same intake and piping system as used for the drinking water. Between the chances of contaminating the drinking water thus and having passengers drink water from the faucets furnishing this wash water, trouble was sure to develop. Inquiry divulged the fact that smaller outbreaks of diarrhea had occurred more or less frequently among passengers, prior to this one which was investigated, while a number of the crew gave histories of persistent diarrhea during the entire season.

In the summer of 1916, an outbreak of typhoid fever which occurred among the crew of a Government dredge at work in the Mississippi River just below the dam between Minneapolis and St. Paul was investigated by the Minnesota State Board of Health and was attributed to the use for drinking purposes of raw Mississippi River water, freshly contaminated by Minneapolis sewage.

During the summer of 1920, a number of epidemics occurred all along the course of the Upper Mississippi from St. Louis to St. Paul, Minn. These epidemics were investigated by numerous local health authorities as well as by the representatives of the health department of the States affected and by the United States Public Health Service.

As in the cases already cited, all the possible sources of infection were considered, and as fast as each was found guiltless it was eliminated. Attention was early called to the water supplies of excursion steamers by the fact that all the sufferers went on excursions on one of two boats—the *Capitol* and the *G. W. Hill*—and by the similarity of the outbreaks to one which occurred at Red Wing, Minn., in 1917 and was traced to the contaminated drinking water supply of an excursion steamer, by the Minnesota State Board of Health. It will be noted that one of the vessels responsible for the trouble was the same one which caused the epidemic in 1912 at Clinton, Iowa, and its neighborhood. By the process of elimination the responsibility was finally traced indubitably to the water supplies of these two excursion steamers.

The apparatus on the *G. W. Hill* was essentially the same as when Surg. L. L. Lumsden inspected it in 1912. There was a Lynn No. 5 filter through which the drinking water and the water used for washing glasses and dishes was passed. The same sea-cock, intake pipe, and pump were used for the flushing, fire-fighting system, and for the drinking-water system, and water was often pumped for washing decks while lying at the bank of the river in close proximity to sewer outfalls. The crew's toilet was about opposite the water intake, on the other side of the boat, and not over 30 feet away. At the time of my inspection, samples of the raw and filtered water were collected. The bacteriological examination, made by the Minnesota State Board of Health, showed total counts of many thousands of bacteria at 37° and *B. coli* present in 1 c. c. amounts in both the raw and filtered water, and, to tell the truth, the filtered water was not very materially improved by the filtration process.

The *Capitol* had a similar intake, polluted by constant use at the sewage-laden levees of the river towns, also used for taking in drinking water when the storage tanks were empty. The crew's toilet was located 20 feet forward of the water intake, on the opposite side of the boat. Raw water was used at the soda fountains for washing glasses and dishes. A No. 5 Lynn filter was used for the drinking water. After passing through this filter, the water went to one of three heating tanks where it was supposed to be boiled for five minutes.

No apparatus was provided for insuring that the water be heated at all, much less boiled for any definite length of time. After being boiled (or not, depending upon the deck hand attending to these things) this water left the tank on the upper deck by the same pipe that had supplied it to the heating tank, thus permitting the boiled water from the tank to mix with the unheated water still in the pipe, thereby making useless the trouble taken to boil it. Some idea of the care taken to boil the water may be gained from the fact that the man having general supervision over this work was the one who said that it was safe to drink raw river water only 60 feet below a sewer outlet.

When I looked into the heating tanks to see the steam coils in the bottom, the water was as turbid as the river, and had to be drained out of the tanks before I could see the coils. Subsequent investigation showed that the filter stone was broken, permitting the water to pass through unfiltered, and the man in charge of it did not know it. Bacteriological examination of samples of this water was made also, which showed that the drinking water had the same *B. coli* content as, and a higher total count on agar at 37° than, the raw water. This high total count was no doubt due to aftergrowths in the tepid water of the tanks after heating.

Still another epidemic traced to polluted water supplies, though not so conclusively as in some other instances, is the following, traced by the New York State Department of Health. During the first week of August, 1920, four firemen on the steamer *C. W. Morse*, plying between New York and Albany on the Hudson River, were taken sick with typhoid fever. These four firemen lived together with eight other firemen on the boat and all ate at the same mess. The water supply used by these men showed the presence of *B. coli*. Milk was used very little by the crew and there was found to be no evidence against the milk supply or other foods. The tracing of the infection to a carrier was difficult, as 19 food handlers left the employ of the company during July, just prior to the outbreak, and could not be located.

The *C. W. Morse* takes its water supply both at New York and Albany by connecting street hydrants to five tanks in the hold of the vessel. From these tanks the water is pumped through pipes to various parts of the boat. The captain said that river water was never put into these tanks and that it could be done only with difficulty by connecting a fire hose to the sea cocks. On the lower deck in the bow of the boat was a wooden keg covered with a loose board top, and to get the water a cup had to be dipped into the keg. In the boiler room there was a water cooler and another in the pump room. These three receptacles were used by the crew.

Samples for examination were taken from the five tanks, from each of the two coolers, and from the keg. The result of the examinations showed *B. coli* in each of the three receptacles used by the crew, but not in the tanks. Unfortunately, no bacterial counts were made and the reports did not give the quantity in which the *B. coli* were found. Another set of samples, taken independently by Dr. Sautter, city health officer, showed *B. coli* to be present in one of the five tanks also, namely, the one supplying the dining room.

But why go on? Enough has been shown in the instances cited to indicate something of the seriousness of the problem and the necessity for immediate concerted action. I would fain speak of the remedies being used, in order to offset the rather lugubrious tone of this recital of disease and death, but the presentation of that feature is reserved for others.

In conclusion, I wish to thank all those, especially the State sanitary engineers and the officers of the United States Public Health Service, who have aided in the collection of data presented in the foregoing descriptions.

Mr. I. W. Mendelsohn presented the following paper:

THE POLICY CONCERNING CERTIFICATION OF INTERSTATE CARRIER WATERS.

In the administration of the present policy concerning the cooperative certification of water supplies used by common carriers for drinking and culinary purposes in interstate traffic, several matters bearing directly on this policy have been noted and will be placed before this conference for consideration. Before proceeding to these matters your attention is invited to the fact that the two fundamental premises in this policy, as adopted at the Surgeon General's conference in 1919, are—

1. The sources of water supplies used by common carriers for drinking and culinary purposes in interstate traffic are to be certified through the cooperation of the State boards of health, or similar State health bodies, and the United States Public Health Service.
2. In order to administer the work effectively it is necessary that each State board of health have an established and fully functioning division of sanitary engineering.

Because over 70 per cent of the water supplies used by interstate carriers are municipal supplies, Congress has expressed itself in no uncertain terms that the quality and safety of these water supplies are of more importance to the State than to the carrier and that each State should take the fullest measures to insure the satisfactory quality of its water supplies. While supervisory powers over waters used by interstate carriers have been placed in the Bureau of Public Health Service, it has been the intention of Congress that this control be carried out by the service with the cooperation and assistance of every State board of health and that no organization be set up in competition with the State health bodies.

Under the act of Congress of 1893, full authority is granted the Public Health Service to prohibit the use of an unsatisfactory water supply for drinking and culinary purposes by an interstate carrier. Unfortunately, full authority has not been granted State boards of health under acts of State legislatures to prevent the use by municipalities of water supplies of questionable purity and safety. There are many water supplies used by interstate carriers for drinking and culinary purposes which can not be considered as free from the possibility of pollution because of some defect in the waterworks system or because of the unsatisfactory operation of the waterworks plant. In some cases, such water supplies are considered unsatisfactory by the State boards of health and recommendations are made to improve the supplies, but the use of such water supplies is not condemned; in other cases, such water supplies are considered by State boards of health as dangerous to the health of the people and their use by the municipalities condemned until certain improvements are made. Accordingly, the situation is often presented of a municipality using a water supply condemned as unsafe by the State board of health and of an interstate carrier prohibited from using such a water supply under the cooperative certification policy, and all the while the people of the municipality are in greater danger of disease outbreak by far than the occasional traveler drinking the water. As a result, a double standard of safety and purity of water supplies is now in existence in many States, which is contrary to the intentions of Congress and unfavorable for an effective administration of the certification policy.

Many of the State boards of health desire that the use of water supplies by interstate common carriers be prohibited when such water supplies have been found to be unsafe by the State boards of health, and all possible action has been taken by them to stop the use of such waters by the communities. If such is the consensus of opinion of this body, the bureau will cooperate with you in enforcing the certification policy accordingly. What is desired for effective administration is one policy agreed to by this conference.

The second point concerns provisional certificates. There are a large number of water supplies, which are not considered by State boards of health as free from danger of contamination due to unsatisfactory operation or some defect in the waterworks system, and yet such water supplies are not considered of such danger as to be condemned for use by communities or by common carriers. There are also many water supplies concerning whose safety and quality sufficient data is not available. For all such water supplies some kind of certificate should be prepared, different from the "favorable" or "unfavorable" certificates, so that proper recognition could be given them in the certification policy.

In view of these conditions, it may be deemed advisable by this conference to have a separate certificate for the provisional use of a water supply, the wording of which would show that the supply was not approved because of certain defects in the waterworks system, and that the use of the water supply could not be approved until these defects had been corrected.

Placarding of condemned water supplies presents another matter for your consideration. The Public Health Service will cooperate with each State board of health in carrying out whatever is deemed advisable by the State board of health in such placarding in the

State, bearing in mind that, as far as local conditions permit, the procedure in all the States should be alike. The use of placards generally has been found of great value by State boards of health in improving their water supplies. But, from an administrative viewpoint, it has not been found advisable nor feasible by the Public Health Service to require the railroads to do the placarding. This case is analogous to that in which placards are placed by city health departments on the doors of city homes where occupants are afflicted with a communicable disease. In regard to placarding, one of the suggestions made to the service is that both the State board of health and the United States Public Health Service should be mentioned on the placard as condemning the supply; another, that placards be forwarded by the State board of health to the railroad station agents with the request that they be affixed over the taps at the station. From an administrative viewpoint, it would seem preferable that placards stating that the water supply was unsafe and its use on cars in interstate traffic was prohibited by order of the State board of health and the United States Public Health Service be forwarded by the State boards of health to the station agents with the request that they be placed over the station taps.

You will be interested to know that the American Railway Association, with a membership comprising over 600 of the railroads of this country, has formed a medical and surgical section to consider matters of health pertaining to the railroads. Through the cooperation of this section, the Public Health Service and the American Railway Association have agreed that all passenger cars now being constructed shall have coolers with separate ice and water compartments and that all passenger cars shall be so equipped by July 1, 1924. From results already obtained, it is believed that the cooperation of the medical and surgical section of the American Railway Association will prove of great value in making effective the administration of the certification policy.

Another matter for consideration is a policy for the supervision of water supplies on vessels. Despite the limited appropriation of $25,000 of the United States Public Health Service to prevent the interstate spread of disease, it was found necessary to commence such supervision in the past few months in view of disease outbreaks last year and in the past on vessels on the Great Lakes and the Hudson and Mississippi Rivers due to the use of polluted waters on board for drinking and culinary purposes. This supervision extends to all vessels plying in interstate traffic, and includes water supplies obtained ashore and afloat and water-supply systems on board the vessels used to furnish water for drinking and culinary purposes. Because of the large amount of additional investigative work involved, it is deemed advisable, from an administrative viewpoint, to divide supervision of vessel waters into two parts—the first part, concerning certification of water supplies ashore, to be carried out in cooperation with the State boards of health, similar to the present procedure regarding railroad waters; the second part, concerning the certification of vessel water systems and water supplies obtained afloat, to be carried out by the United States Public Health Service. It is intended to pay particular attention to vessels on the Great Lakes and the Mississippi River and its tributaries, considering first of all passenger and excursion vessels, and then freight and other vessels as funds and personnel permit. The fullest cooperation of all the State boards of health is necessary to make this supervision effective.

The States have been grouped into nine districts and a Public Health Service sanitary engineer placed in each to carry out certification of railroad and vessel waters. These sanitary engineers, as far as possible, will be available to assist the State boards of health in their districts in this work and in developing the sanitary engineering divisions in those State boards of health. In addition to these district sanitary engineers, representatives of the State board of health have been appointed in 14 States as collaborating sanitary engineers of the Public Health Service to assist the State boards of health temporarily in carrying out the certification policy until more adequate appropriations are obtained from the State legislatures.

Largely as a result of the cooperative policy, functioning sanitary engineering divisions have been established in 10 State boards of health in the last two years. At present there are 35 functioning State sanitary engineering divisions, in addition to three other divisions which will be established beginning July 1, 1921. Present indications are that within the next two years sanitary engineering divisions will be established in three other States. Valuable assistance has been rendered practically every State board of health in improving the municipal water supplies through the administration of this policy. According to the certificates received and the information obtained, no condemned water supplies are being used by common carriers for drinking and culinary purposes in interstate traffic. The sources of water supplies have been certified, however, in only 50 per cent of the cases during the present fiscal year.

From the experience of the past two years in carrying out the certification policy, it is believed that consideration should be given the following matters to make this policy of greater value to all State boards of health:

1. That there be one policy agreed to by the State boards of health concerning water supplies of unsatisfactory quality and safety.

2. That water supplies which are not considered either safe or dangerous, or concerning which sufficient data is not available be included in the certification policy by some form of provisional certificate.

3. That placards for prohibited supplies signify the governmental authority condemning the water supply and be posted through some form of agreement with the carriers.

4. That some policy concerning the supervision of vessel waters and vessel-water systems supplying water for drinking and culinary purposes on board vessels be adopted.

The bureau desires your advice in formulating procedure which will solve the problems presented above.

Mr. Ellis S. Tisdale submitted the following paper:

COOPERATION OF STATE HEALTH DEPARTMENTS IN THE CERTIFICATION OF INTERSTATE WATER SUPPLIES.

Mankind is subject to certain diseases, for the eradication of which both the science of medicine and of engineering are necessary. They furnish, as it were, points of contact for these two professions. Notable among these diseases stand yellow fever, malaria, and typhoid fever. The latter disease has a very definite relationship to drinking-water supplies. Probably the subject of " interstate water supplies," fully as much as that of malaria or typhoid fever, has been instrumental in bringing together from all parts of the United States this representative body of sanitary engineers. The first step tending toward the formation of a State sanitary engineers' association, if I read the movement rightly, was the commendable practice by certain State health officers of bringing their sanitary engineers to the annual conference of State and Territorial health officers, that they might profit by the engineers' advice on matters where the sciences of engineering and medicine overlapped.

In 1919, due to the growing importance of sanitary engineering divisions as they relate to this question of interstate water supplies, an invitation went out to all States requesting the presence of the sanitary engineer at the annual conference. That the subject of interstate water supplies is an important one is amply attested by the increased consideration being given to this subject by health officials when they meet to discuss their mutual problems. In 1918 and again in 1919 this question was brought up at the annual conference of State health officers with the United States Public Health Service.

That the subject is receiving the thought which it merits is due probably to the persistent, untiring efforts of Dr. Allen J. McLaughlin, Assistant Surgeon General of the United States Public Health Service. Back of all movements of progress in our history, be they of art, science, or government, will be found leaders, men who by their constructive thought and action, have led the way. The sanitary engineers throughout the United States have had such a leader in Dr. McLaughlin, and he has put the virility and forcefulness of his personality into the problem of bettering interstate water supplies. His has been the guiding hand which is placing sanitary engineering work in the State health departments on a higher plane. For a long time this work of certification was carried on in a way that savored of red tape and impersonality. Of course, to a certain extent this is unavoidable, where supervision is maintained over a large area like the whole United States and must be carried on for the most part by correspondence. But at last someone's vision and active interest has found a way to eliminate much of the rigidity and inelasticity of the work of certifying to the purity of these supplies.

The type of certificate in use in the Treasury Department from 1913, when interstate water control was started, up to 1919 was a poor instrument for registering the record of interstate water supplies. The standard upon which the whole scheme of certification was based was that of bacteriological tests alone. It was not a medium through which could be transmitted the mature judgment of the engineer investigating and certifying the water supply. It provided no sanitary survey record, an element which is considered to-day of as great if not greater importance than the bacteriological content.

The Public Health Service, desiring to make the procedure of certification more flexible and in accord with the best judgment and experience of the sanitary engineers of the States, had a thorough and detailed investigation made by representatives of the service. During 1918 and 1919, Dr. F. A. Carmelia and Mr. C. N. Harrub visited each State department of health and obtained information regarding the facilities, the organization, and personnel of the sanitary engineering division or that division which was looking after the water supplies in the State. Not only this, they attempted to obtain the viewpoint and opinion of the engineers actually doing the certification. Constructive criticism was welcomed.

As a result of this very detailed study, data of the most valuable character was gathered and correlated. The common factor in the criticism regarding the certification process seemed to be the inadequacy of the certificate based upon single bacteriological analyses.

Dr. Carmelia very clearly stated, in outlining future plans before the annual conference in 1919, that sufficient consideration reveals the unsoundness of the premise that the control of water supplies should be standardized for all States alike and accordingly also for use in interstate traffic for drinking and culinary purposes.

It seems to me that this whole question has an analogy in a rough way to the sanitary privy situation. One final arbitrary standard was sought for years through patient research and extensive field experiments. At last, in this field of rural sanitation, the conclusion was reached that we must rely upon the judgment of the engineer as to the type of privy best suited for the locality and situation. With regard to the certification procedure, Dr. Carmelia says, in summing up his results: "It is impossible to make arbitrary standards and procedures take the place of the exercise of judgment in determining the potability of any given supply. And judgment comes with experience. Each water supply must be weighed individually on its own merits." Thorough consideration given the problem of certifying water supplies also shows clearly the advisability of limiting the cooperative control to the several States and the Public Health Service. Local municipal control reporting direct to the service makes an undesirable short circuit which creates havoc with the entire cooperative arrangement between States and the Public Health Service.

The basic future Federal program, which was outlined in Dr. Carmelia's paper before the annual conference in 1919, consisted of three important features. They were: (1) A sufficiently elastic regulation to meet the regional diversities in a satisfactory and practical requirement for potability. (2) A definite program and offer of assistance to those States which are most in need of and can most profitably take advantage of such assistance. (3) A definite plan whereby the Public Health Service can become a medium of interchange of ideas, laws, and procedures among the various cooperating States for effective coordination of effort for the common advancement of water control.

Let us see how practical and workable these three channels of activity have proved to be. The revised regulation adopted at the 1919 annual conference was a great step in advance. Its main provisions can be briefly summarized as follows:

1. It provides that the safety and sanitary quality shall be based upon (*a*) sanitary survey, (*b*) bacteriological analyses, (*c*) chemical analyses. Survey and laboratory methods shall be followed which are acceptable to the Surgeon General of the Public Health Service.

2. Certificates may be issued only by officers of the Public Health Service or by the respective State health departments having jurisdiction over the water supply. No other authorities will be recognized.

3. The period of certification is made semiannual in general; but when common sense and judgment show the advisability, an annual survey and certification is sufficient.

4. Proper handling of the water supplies in placing water on trains at division points and terminals is provided for. Also in all new equipment, ice is not to come in contact with water in the water cooler.

5. The regulation is extended to cover vessel waters as well as railway waters. This policy of certifying vessel waters covers the entire United States and provides for water obtained both ashore and that furnished by water supply systems on board vessels.

The second feature of the Federal program relates to the work of assisting in the establishment of new divisions of sanitary engineering, for this division is the State machinery which should do the actual work of certification.

The Public Health Service has no desire to set up a separate and duplicate set of machinery throughout the United States to handle this work of safeguarding interstate waters. It would be an uneconomic expenditure of funds and effort. It does desire to use to the fullest extent the existing State machinery. The division of sanitary engineering in each State health department may well be likened to a link in the chain of this consolidated machine, which functions to protect and safeguard the water supplies used in interstate traffic. The links of the chain are weak and ineffective and allow disease to creep in wherever the sanitary engineering divisions are lacking or too small to function properly.

The position which the service aims to fulfill is to care for the water supplies in these weak States and to demonstrate to the States the need for a sanitary engineering division and to strengthen already existing organizations. How successful has been the endeavor in this direction during the year just passed? Missouri, South Dakota, New Hampshire, Mississippi, Georgia, Kentucky, and Tennessee have made provision for a sanitary engineering division in the past year, mainly due to the stimulation and effective work of the Public Health Service engineers. The first three named States will start the work of engineering July 1. The States of Tennessee, Kentucky, and Georgia for quite a period of time received the help of a service engineer, but now finance a full-time engineer themselves. In Mississippi the engineer was appointed in October, 1920. Thus in these seven States successful demonstrations have been staged. Work is now being carried forward in Washington and Oregon and other Western States to place the engineering work on a full-time basis. Also Arkansas, Oklahoma, Nebraska, and Delaware received considerable assistance during 1920.

The third feature of the Federal program has also been functioning. The medium in the Public Health Service for the bringing of all State sanitary engineers into closer contact is the office of corresponding secretary of the State Sanitary Engineers' Association, which is maintained by the United States Public Health Service. The association is as yet an infant, but there are great possibilities for it in the future, if all State health departments sense their responsibilities and the engineers themselves lend their loyalty and efforts toward the development of the association. I am much indebted to the present corresponding secretary for help given in getting up-to-date information upon the subject matter of this very paper.

What are the fundamental items of a State program which will match the Federal program which was proposed in 1919 and is being carried forward with good promise?

1. The fundamental attitude of the Public Health Service must be understood and an expression made by each State whether it will cooperate along the lines indicated. This cooperative contract can not be properly carried out unless each party understands his part to the contract.

2. The certificate should be carefully considered by the State health department, and if any points of difference arise they should receive free discussion.

3. Uniform laws should be adopted in each State with regard to the railway sanitary code as promulgated by the "committee on health and medical relief" at the annual conference last year.

4. The question of the certification of vessel water needs careful consideration and an expression made of the policy which will be adopted by each State.

Let us see what the State program, consisting of these four points, has to offer and how the States can best proceed with their part in the cooperative scheme. Probably the greatest factor in getting the first point well established—that is, a conception of the Federal program and expression from each State as to its part in the contract—has been the bringing of the service engineers and State engineers together. It has been accomplished in two ways, (1) by helpful visits of inspection of the service engineers to the several States and (2) by the coming together of the men in the annual conference last year.

The second point deals with consideration of the certificate itself. Can any suggestions for betterment still be made so that the certificate itself or its issuance will be even more practical than at present? The question has been raised as to whether it would not be preferable to express the bacteriological findings in a different manner. At present the certificate asks for the average number of *B. coli* per 100 c. c. and the total content of 37° C. bacteria per c. c. Would it not be better, in view of the varied conditions both with respect to laboratory equipment, personnel, and methods, to state the number of times that *B. coli* are found present in 1 c. c., 10 c. c., or 20 c. c. of the samples examined. I understand that the State of Kansas has adopted this way of reporting the *B. coli* content. It seems to me that a better bacteriological picture would thereby be given and this particular section of the certificate improved.

What about provisional certificates? During March, 1921, four rulings by the Public Health Service were issued which dealt specifically with this question. It is the opinion of at least some of the State engineers, who have been following closely the certification of railroad supplies for many years, that these rulings regarding provisional certificates will seriously retard progress. Whereas, formerly the State department of health, through refusing to issue a certificate, had a real lever with which to work to make safer municipal water supplies, now this help has been withdrawn. Let these features as to the form of certificate regarding bacterial content and the issuance of provisional certificates receive free discussion. If State machinery and personnel are to be freely used in developing this cooperative plan, is it not wise and fair that an expression be obtained from them before far-reaching decisions are made which affect the States and their work?

The third feature of the State program offers the suggestion that an attempt be made to obtain a uniformity of laws in the several States with respect to a sanitary code. The committee on health and medical relief of the annual conference of State and Territorial health officers worked with a will in drawing up a sanitary code which would be agreeable and satisfactory alike to the railroads, to the Public Health Service and to the States. At the annual conference in 1920, this railway sanitary code was officially adopted. I understand that already five States—Alabama, Florida, Kentucky, Minnesota, and Wisconsin—have enacted it into law. The enactment of the code in each State would aid materially in the work which the Public Health Service has under way of bettering the handling of interstate supplies at stations. Considerable discussion has arisen in the past as to whom this duty belonged. The several district service engineers are now attempting to supervise and better this feature of the work, especially at the big terminals, and it will be of great assistance to have uniform laws regarding this matter in all States.

The sanitary code provides that unsatisfactory waters shall be posted in the stations. I know in West Virginia this way of showing the unsatisfactory character of water to the public has enabled our department to make many improvements otherwise impossible. Even though there is a contention by the railroads as to the unfairness of placarding a supply and forbidding its use on trains when the community still uses it, I feel that the adoption of a temporary provisional certificate allowing the use of the water and not forbidding it, takes from us an effective lever for bettering municipal supplies. And, as I understand it, bettering public water supplies is one of the main drives which the Public Health Service is making. However, each State should make clear to the Public Health Service whether the State desires to take the responsibility for the placarding or have the Public Health Service assume it.

The fourth and last point with which the State is concerned is formulating her program relative to vessel water supplies. The

United States has been divided into nine districts in the water control work of the Division of Domestic Quarantine. A service sanitary engineer, is, or will be, assigned to each of these districts. Supervision of water systems on board vessels comes directly in the line of duty of these engineers and they should know the policy of the State with regard to vessel water supplies which are obtained on shore. Thus they can plan their work accordingly.

I have tried to present briefly the essential features as I see them of a true cooperation between the States and Public Health Service which, if effected, will promote the work of making safe interstate water supplies. To me there is great hope in this tentative organization of ours, the State sanitary engineers' association. It gives that personal touch which is so essential in vitalizing an understanding. The engineers of the many States and of the Public Health Service meet and exchange ideas. Thus we have a real clearing house to rid the atmosphere of any frictions, mistaken ideas, or false impressions. It furnishes that opportunity, so essential to real progress, of getting away from one's work and getting the other fellow's viewpoint on the question. Such a meeting as this affords us a platform, as it were, from which we can command a view of our present position, a purchase by which we may move it.

With the older States, where the work has progressed considerably, contributing their knowledge and experience to help the States younger in this work, and with a leader of vision, judgment, and force such as Dr. McLaughlin, who has advanced and is advancing the sanitary engineering side of public-health work to the utmost of his ability, we engineers should give our utmost loyalty and cooperation toward making this organization an effective unit for progress.

A motion was made, seconded, and approved to appoint a committee to consider the matter of certification of water supplies used by common carriers for drinking and culinary purposes in interstate traffic. The committee consisted of Mr. Tisdale, chairman; Mr. Emerson, Mr. Gage, Mr. Rich, and Mr. Mendelsohn.

The conference then adjourned for the day.

Morning Session, June 2, 1921.

The second day's session was called to order at 9.30 a. m., Mr. Emerson presiding.

Mr. A. E. Gorman presented the following paper:

REPORT OF CONDITIONS UNDER WHICH DRINKING WATER IS BEING SUPPLIED ON VESSELS OPERATING IN INTERSTATE TRAFFIC ON THE GREAT LAKES, WITH REFERENCE TO TYPHOID FEVER AMONG GREAT LAKES SEAMEN.

The problem of maintaining a safe water supply for drinking and culinary purposes aboard vessels operating on the Great Lakes is different from that for transoceanic, coastwise, or river vessels, because of the physical and chemical properties of the water of these lakes. The high salt content of sea water automatically prohibits its use for drinking unless distilled; the turbidity of the waters of the large navigable rivers of this country often serves as a check against their use for similar purposes on river vessels, because people are becoming more and more suspicious of an unclean water; but on the other hand, the fresh waters of the Great Lakes with their agreeable taste, low turbidity, and relatively low temperature, meet all the outward demands of seamen and the traveling public for an ideal drinking water supply.

While it is true that in large areas of the Great Lakes, the waters are of high sanitary quality and might be safely used for drinking purposes, nevertheless in the vicinity of the larger cities, they are often grossly polluted by sewage from the cities and as a result are usually highly contaminated.

The heaviest merchant shipping and the greatest passenger traffic is, of course, centered around the large lake cities, so vessels in arriving and departing, as well as while docking, at these ports are in waters subject to and grossly contaminated by sewage pollution. Furthermore, since vessels travel in fairly uniform courses between ports and as the sewage from these ships themselves is discharged directly overboard, there is always the potential danger of the sewage from one ship contaminating the water supply of others in its wake, even if the seamen of the latter vessels are careful to fill the drinking water tanks aboard only when the ship is distant from possible shore pollution.

Cobb,[1] in 1909, called attention to the dangerous practices in connection with the supplying of drinking water on Great Lakes vessels and showed that the high typhoid fever rate among lake seamen was contributed to largely by contaminated drinking water supplied aboard. Young,[2] in 1910, concluded from a study of typhoid fever among seamen that its rate was higher among Great Lakes seamen than those working on coastwise or river vessels, and also higher than the rate in cities of the Lakes district. The outbreak of an epidemic of gastro enteritis and typhoid fever among members of an excursion party which took passage on steamship *Rochester*, in the summer of 1913, is a classic of its kind. De Valin, in his report on this outbreak, states that information received from 235 members of this party showed that 122 cases of gastro enteritis and 42 cases of typhoid fever, with 5 deaths, resulted from the drinking of contaminated water aboard this vessel, taken on from Lake Erie. In 1914, De Valin also studied the typhoid fever epidemics on steamship *Gopher* and steamship *Huron* and concluded that contaminated water from the lakes was responsible for both of them.

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[1] Surg. J. O. Cobb, United States Public Health Service, Journal of American Medical Association, vol. 53, p. 2057, Dec. 18, 1909.

In 1915, a systematic study of the methods under which drinking water was being supplied on vessels operating on the Great Lakes was begun. This work was carried on under the supervision of Surg. J. O. Cobb, United States Public Health Service, who was then officer in charge of the Great Lakes sanitary district, with headquarters at Chicago, Ill.

As a result of this investigation, it was found that in general the practice on lake vessels in connection with the supplying of drinking water was entirely unsatisfactory for proper protection to seamen and the traveling public; and that the apparatus then in use for sterilizing such water aboard many of the passenger vessels was "woefully inefficient." An excellent report on this investigation and the work which followed was written by Cobb Williams, and Letton, of the Public Health Service, and published in Public Health Reports of October 13, 1916.

In view of the inefficiency of the apparatus then used aboard vessels for disinfecting lake water, a study was subsequently made of their design and operation, for the purpose of assisting in the development of adequate control and operating appliances necessary to make them satisfactory for the purpose for which they were purchased. The different processes then in use for treating lake water on passenger vessels operating on the Great Lakes were rapid sand filtration, electric rapid sand filtration, filtration followed by ultraviolet ray sterilization, sterilization by calcium hypochlorite, and sterilization by liquid chlorine. A study was also made of other types of water disinfecting apparatus then on the market, to determine their efficiency and practicability for use on vessels.

After several recommended adjustments were made and additional control devices included in the apparatus studied and tested, three methods for disinfecting lake water aboard vessels were finally approved, namely, distillation, heat treatment by steam, and ultra-violet ray sterilization. The first method was described in letter of March 10, 1916, sent out by the Great Lakes sanitary district to all owners and agents of lake vessels as being "foolproof, automatic in action, and not dependent on the human agency for its efficiency;" and the other two methods as, "as near foolproof and automatic in action as possible with any apparatus having moving mechanical parts."

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[2] Surg. G. B. Young, United States Public Health Service, Second Report of the Lake Michigan Water Commission, p. 97, 1911.

The following regulations announced in Treasury Department Circular No. 72, dated February 12, 1917, were adopted as a result of the investigations of the Great Lakes sanitary district:

> On and after the official opening of navigation in 1917, any person, firm, or corporation operating vessels in interstate traffic on the Great Lakes will be required to furnish on such vessels water for drinking or culinary purposes under one of the following conditions:
>
> (*a*) If water for drinking or culinary purposes is not obtained ashore, it must be treated by an approved method.
>
> (*b*) If water for drinking or culinary purposes is obtained ashore, it must be from an approved source.
>
> On and after the official opening of navigation in 1917, the piping system on all vessels must be so arranged that no connection can be made between the drinking-water system and any other water system.
>
> On and after the official opening of navigation in 1917, an approved sign reading "Do not drink this water," must be properly placed at every tap or other outlet not connected with the drinking-water system.
>
> Lake carriers are requested to acknowledge the receipt of this letter.

From the first, few of the vessel owners and managers were interested in the provision of these regulations allowing the use of water obtained from an approved source or sources ashore, and therefore, in order to comply with the law, immediately set about to determine which of the different apparatus for treating water, in accordance with the three approved methods, would be most practical for installation on their respective vessels. The reason for this action is quite obvious to one familiar with conditions in connection with Great Lakes shipping.

On the large passenger boats having well-appointed staterooms, parlors, and dining rooms, great quantities of water are used for washing, bathing, cooking, and drinking purposes. Tanks for storing sufficient water obtained from a source ashore to last a trip, whether overnight or of several days in length, would take up considerable space on a vessel. The stop-over at some ports was not sufficient to allow filling of these tanks. Also, at several of the large cities on the lakes, the public water supply was periodically turbid and in general unpopular with seamen, because of not infrequent disagreeable tastes in same caused by a chemical used for sterilization. This water was therefore not considered as desirable for drinking, cooking, and other uses on passenger vessels as the lake water which could be taken on en route. Furthermore, on a number of these vessels apparatus for treating lake water had already been installed.

In freight shipping the docks are along rivers, canals, and slips at the cities, and the wharves at which the vessels stop are very often not equipped with hydrants for supplying drinking water. Bulk freighters load and unload at many different wharves throughout the navigation season, and therefore even if such water was conveniently available at one port, it might not be at another. Furthermore, these vessels are often several days en route between ports and can not afford to be dependent for their drinking water supply on sources ashore. The distillation of lake water was given most serious consideration by owners of freight vessels, because the quantity of water used for drinking purposes aboard these ships was relatively small and steam was conveniently available.

For companies operating vessels in regular ferry freight or excursion service of a few hours' run and calling at the same wharves each trip, to obtain drinking water from sources ashore was a simple matter.

The expense to the shipping interests in complying with the new regulations of 1917 was not a small item, and although they registered objections, because of this, at the time, when it was made known that the policy of the United States Public Health Service would not be altered, they met the situation promptly. For the owners of vessels operating in passenger service on which water-treatment apparatus of an approved type were already installed, it was only necessary to make the specified changes or purchase additional control equipment in order to meet the Federal requirements. But freight carriers on whose vessels drinking water had always been obtained direct from the lake were obliged to purchase entirely new treatment apparatus and equipment.

Unfortunately for this work, shortly after the opening of the navigation season of 1917, this country entered the World War and the personnel of the Great Lakes sanitary district was shortly afterwards detailed to war service. In consequence, little supervision or control was exercised over the water supplies on the lake vessels that season, after the treatment apparatuses were installed. Not until the summer of 1918, or over a year later, was any regular supervision again attempted by the Public Health Service. At that time it was found that on many of the vessels the apparatuses for treating lake water, used for drinking and cooking purposes, were not being properly operated, and in many instances were not being operated at all.

The reasons for this laxity are not difficult to understand. A large percentage of Great Lakes seamen did not then, and still do not.

appreciate the potential dangers in connection with the practice of obtaining drinking water used on vessels from the lakes. They are not a little bit suspicious of and often entirely out of sympathy with any treatment process for disinfecting water, preferring to drink the clear, cool, and agreeably tasting water direct from the lakes. The "flat" taste of distilled water was the subject of much criticism by seamen on freighters the first year during which drinking water on these vessels was distilled, and even now there are many seamen who dislike such water. In addition to these features. the operation of the new water treatment apparatus demanded the attention of the engineers or their assistants, and, not being a part of the machinery necessary for the navigation of and the work aboard the ships, these apparatuses were often neglected.

Although on account of the demand for the service of its officers in war work the Public Health Service did not attempt to maintain an effective control over the drinking water supplied passengers and crews on Great Lakes vessels after the regulations of 1917 became effective, nevertheless, through the activities of the Detroit department of health excellent control measures were carried out on a majority of the large lake passenger vessels. As early as 1915 the Detroit department of health had made careful studies of the conditions under which drinking water was supplied on passenger vessels calling at that port, and some of its investigations were entirely pioneer work in this line. The stand which this health department has taken is that the sanitary quality and safety of the drinking water on the passenger vessels calling at Detroit is an important factor influencing the health of its citizens, and therefore is a public health problem to be solved locally, if not efficiently handled by other agencies. As a majority of the large passenger vessels call at Detroit, this far-sighted policy of that city's health department has been far-reaching in its effect.

During December, 1920, and January of the present year the writer was detailed to make a study of the conditions under which water used for drinking and culinary purposes was being produced on vessels operating in interstate traffic on the Great Lakes. An investigation was made, in this connection, of the number of vessels of different classes in service on the lakes, of the treatment apparatus used aboard each for disinfecting drinking water, and of the typhoid fever cases among seamen in the Great Lakes district since the regulations of 1917 went into effect. The following table gives the number of American registered vessels of different classes reported as operating on the Great Lakes during the navigation season of 1920 and the number of water treatment apparatuses aboard same. Vessels listed as over 300 gross tonnage engage generally in interlake traffic:

Type.	Vessels.	Water-treatment apparatus.	Per cent treatment apparatus.
300 gross tonnage or less:			
Passenger	29	....	....
Freight	24	2	8.4
Barge	17	....	....
Car ferry	....	....	....
Gross tonnage over 300:			
Passenger	58	36	62.0
Freight	481	403	83.7
Barge	128	47	36.7
Car ferry	20	6	30.0
Total:			
Passenger	87	36	41.5
Freight	505	405	80.0
Barge	145	47	32.4
Car ferry	20	6	30.0

With the one exception of the steamship *Calcite*, on which drinking water is sterilized by the ultra-violet ray process, all freight steamers, car ferries, and barges listed above as having water disinfecting apparatus aboard are equipped with stills. On the vessels of this class not so equipped, especially on those of over 300 gross tonnage, the drinking water is obtained regularly or when necessary direct from the lakes.

The water-supply system on the large bulk freighters, which class represents 76 per cent of all the vessels operating on the Great Lakes, are quite similar. Water used aboard for general purposes, such as for boilers, washing decks, "shooting" ashes, fire service, etc., is taken on from the lakes through a main seacock, and pumped throughout the ship as needed. Water-storage tanks of from 300 to 500 gallons capacity, usually three or four on the upper aft deck and two or three on the upper forward deck supply water under gravity pressure for washing in the quarters of the officers and seamen aft and forward, for general purposes in the galley, and for flushing toilets. These tanks are usually filled from the fire-service line on the upper decks through hose. As a rule care is taken to fill them when the ship is several miles out in the lakes, and always before entering port.

The water which is to be distilled for drinking purposes is usually, although not always, delivered to the still by a special pump. In many cases this pump is the same one which pumps cooling water to the engines and shaft bearings; and on not a few vessels this water is taken on through a special seacock. The stills on the lake freight vessels are practically all of 25 to 30 gallons per hour rated capacity. The condensed steam from a still is discharged into a collecting tank of about 100 gallons capacity, in which a float arrangement is set for automatically turning on the steam supply to a small horizontal pump when the tank is filled. This pump delivers the distilled water to the storage tank on the upper aft deck, and its steam supply is automatically throttled when the collecting tank is emptied. The distilled water storage tank is similar to and set alongside of the storage tanks for untreated lake water. Unless it is conspicuously marked to identify it and the covers locked, it would not be unnatural for an ignorant seaman or even inconvenient for a careless one to fill this tank when the other water tanks are being filled. The writer visited five vessels in South Chicago in one day last month on which this very thing had been done.

The distilled water is delivered by gravity pressure through a separate piping system to the drinking-water taps on the decks aft or in the galley quarters. On most of the freight vessels this water is first cooled by passing through coils set in the ice box. There are usually two or three drinking-water taps on the aft deck, but none forward or in the lower engine or boiler rooms. As a result, if a seaman in any one of these parts of the ship desires a drink of water and does not care to go aft or above deck to obtain distilled water, he may drink untreated lake water either from cooling jets to bearings or a pet cock in the manifold piping, if available. This water is usually cold. In the forward quarters lake water is available at all taps, although signs are posted over each, warning that the water is not to be used for drinking. During the summer months this water is not likely to be as cool as that at the drinking-water taps aft, because the storage tanks located on the upper deck are exposed to the sun. In the engine room, however, cold lake water may be readily obtained from the sources described above, and therefore, unless some provisions are made to supply cold distilled water to all parts of the ship, it is certain that lake water will be drunk by seamen. The practice of engine-room and fire-hold employees is especially dangerous, because they are often ignorant of the waters through which the ship is passing. It would be interesting to study the occupations of the Great Lakes seamen who have been hospitalized in the last few years for typhoid fever and to note the effect of this practice.

In the galley quarters the water-piping system on many freight vessels is so arranged that violations of the interstate quarantine regulations is made easy. Over the sink in the galley three taps are usually located. One is for hot water from the hot-water boiler connected to the range; a second is for untreated lake water direct from the storage tanks on the upper deck; and the third is for the cold distilled water. It is alleged, of course, that the untreated water is used only for washing in the galley quarters, and a sign is placed over the tap in accordance with the regulations, stating that this water is not to be used for drinking purposes. However, when the still is not in operation (the writer has been on several boats this spring on which the stills were not even connected) the employees in the galley have no other cold water to use except this untreated lake water.

As stated above, among Great Lakes seamen there is no little prejudice against the use of distilled water for drinking and cooking purposes. Thus an engineer or his assistants may willfully neglect the still, and even though this supply of water becomes exhausted, the employees in the galley are not liable to report this fact or even register a complaint as long as the untreated lake water is available. For real protection of the health of seamen, it is believed that no untreated water should be allowed in the galley quarters. The complaint that a 30-gallon per hour still will not supply sufficient distilled water for drinking and culinary purposes for 30 men aboard a vessel is not well grounded if this water is at all economically used. The Lake Carriers' Association, which body represents about 80 per cent of the freight vessels operating on the Great Lakes, has recommended that the untreated water supply be allowed in the galley, but that the tap be removed from over the sink and located at a point 18 inches from the floor, so that this water could be drawn in pails for use in cooling hot water and also for washing and scrubbing purposes in the kitchen.

It is known that on many of the freight vessels the stills have not been used regularly since they were installed, but it is believed that on a majority of these vessels care has been given to their operation. One instance was reported to the writer this spring where the condensed steam collecting tank from a still was filled regularly with lake water, direct from the general service supply, through a hose, the still not being operated at all, although it was properly installed and connected.

Apparatus for treating lake water by all three of the approved methods have been installed on passenger vessels. On some of the vessels of this class, having short routes only, water from certified sources ashore is carried, while on ferries of few minutes' run no water at all is supplied passengers. The following table is a compilation of the different methods by which water for drinking and culinary purposes on passenger vessels of American registry of the Great Lakes is obtained, as reported by the owners or managers:

Source and treatment.	300 gross tonnage or less.	Over 300 gross tonnage.	Total.
From lakes treated aboard by—			
R. U. V. sterilization		27	27
Heat treatment by steam		5	5
Distillation		5	5
From lakes untreated	25	11	36
From sources ashore	4	10	14
Total	29	58	87

On most of the passenger vessels having the ultra violet ray and steam ejector apparatus for disinfecting lake water, all the water on the ship except that used for washing decks, flushing toilets, and in the boiler and engine rooms is treated, the operating companies preferring to incur this expense rather than have to post warning signs in all washrooms, staterooms, and on decks over taps at which untreated water would otherwise be available. The few large passenger vessels on which stills have been installed, have the dual water systems aboard, owing to the expense of supplying distilled water for other than drinking purposes and consequently in the washrooms, staterooms, and kitchens untreated lake water is available, although over the taps warning signs are posted.

Separate seacocks and pumps are provided on most of the passenger vessels for taking on and delivering the lake water to be treated aboard to raw water storage tanks. From these tanks the water is pumped to or through the treatment apparatus and as discharged from same is piped to the sterilized water storage tank or tanks either under gravity pressure or the direct pressure from the pump. It is then pumped to the distibuting system throughout the ship at a pressure of from 30 to 40 pounds per square inch. On several large passenger vessels, no storage for sterilized water is provided at all, the water being pumped through the sterilizer to the distributing system direct. As the new regulations do not permit the existence of by-passes, the owners of these ships are now arranging for future installations of reserve tanks. The sterilized water storage tanks on most passenger vessels are located in the hold of the ship. On a few of these vessels the sterilized water storage tank is formed by a bulkhead across the ship, the hull serving as part of the tank. This is a very bad practice, as the vessel might strike an obstruction in a channel and open a seam in the hull of the ship allowing contamination of the sterilized water by sewage polluted water. On one vessel operating out of Chicago, a sewer line was found to pass through the drinking water storage tank.

By-passes around all or part of the water treatment apparatus were found installed on every passenger vessel on the Great Lakes which the writer has inspected to date. Cross connections between the treated and untreated water systems aboard were also found on many ships, the two systems being separated only by hand-operated valves. In three specific instances the valves in by-passes were found open while the water-treatment apparatus was in operation. These by-passes and cross connections are of course potentially dangerous and under the new regulations are prohibited.

In the ultra-violet ray process for sterilization, the lake water must first be filtered to remove any turbidity, prior to passing through the sterilizer. This is because these rays will not penetrate any solid material, except fuzed quartz and ice, and therefore bacteria in the water passing through the sterilizer might be protected by the shadows caused by tiny particles in suspension. Pressure filters are used on all the boats for this preliminary treatment. Fortunately, the waters of the Great Lakes are not often very turbid.

The efficiency of the mercury vapor lamp, used in this process, for emitting ultra-violet rays of sufficient intensity to sterilize the water at the rate it is passed around the lamp, depends on the voltage across this lamp. In order that no water may pass through the sterilizer before the voltage across the lamp has reached the range of its maximum efficiency, a solenoid-operated valve is placed in the water line to the sterilizer, which is supposed to automatically close when the lamp is not lighted and not to open again until the voltage across the lamp has reached at least 135 volts. In checking the operation of these solenoid valves, the writer found several of them opening at much lower voltages, and adjustments were made accordingly. Where such conditions existed, of course, there was danger of water passing to the storage tanks before being effectively sterilized. All the ultra-violet ray sterilizers on the lake boats, which the writer has inspected, were of the pressure type, most of them operating on 220 volts direct current. Special motor-generator units are necessary for these sterilizers in order to insure a uniform voltage. It is of great importance that the voltage across the lamp be maintained at about 280 volts, or else the efficiency of the lamp in emitting ultra-violet rays will be reduced. In the original installation of this type of sterilizer, as approved for use on vessels, automatic lamp-tilting devices were installed with each outfit, but experience in the use of this automatic mechanism has justified its abandonment in favor of a hand lamp-tilting arrangement. The sudden closing of the automatic lamp tilter caused the mercury to flow quickly into the bowl of the lamp, where the impact was often too great a strain for the quartz to stand, and as a result breaking and loss of vacuum in lamps were not an infrequent occurrence.

Thermostatically controlled valves opened and closed by hydraulic pressure, regulate the operation of the steam ejector process of disinfecting water by heat treatment. By means of this control, no water is supposed to discharge to the sterilized water storage tanks, until it has first been heated to a temperature of 212°–220° F. and retained within that range of temperature for approximately three minutes. In one of the passenger boats, last season, a coil in the cooling tank leaked and permitted contamination of the disinfected water by water from the lakes. No arrangement for checking the operation of the valves at the rated temperatures was provided with any of these apparatuses, and subsequent tests of same on five vessels showed that all such valves were out of adjustment.

In discussing the above features relative to the conditions and practices in operation, under which water is supplied for drinking and culinary purposes aboard vessels plying on the Great Lakes, it is not the intention of the writer to convey the impression that the water treatment apparatuses are not sufficient, when properly operated, but the writer wishes to emphasize the fact that careful and intelligent operation of the same has not been practiced, in many cases in the past, especially on those vessels which were not under the supervision of health authorities.

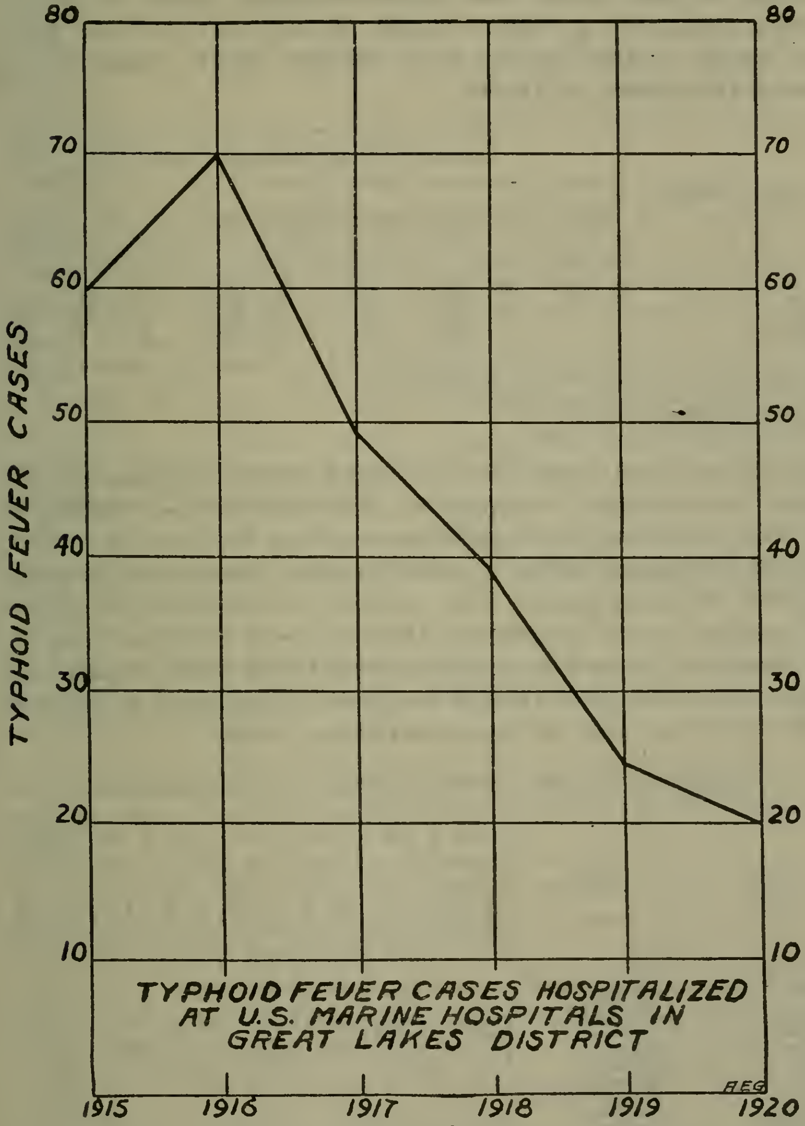


FIG. 6.

The following table showing the conformity to the Treasury Department bacteriological standard—for water used for drinking and culinary purposes on vehicles operating in interstate traffic—by samples of water taken from aboard passenger vessels calling at Detroit during the navigation season of 1920, was compiled from data kindly supplied by Mr. W. F. Walker, deputy commissioner. Detroit Department of Health:

Source or treatment.	Conformity to Treasury Department standard.								
	Samples.	Count 37° C.	Per cent.	Samples.	B. Coli per 100 c. c.	Per cent.	Samples.	Both.	Per cent.
R. U. V[1]	189	177	93.4	154	122	79.3	154	110	71.4
St. Ej.[2]	107	53	49.5	86	35	40.7	84	34	40.5
Still[3]	5	3	60.0	4	4	100.0	3	2	66.7
City water[4]	12	12	100.0	10	8	80.0	10	8	80.0

[1] 14 vessels, filtration and ultra violet ray sterilization.
[2] 5 vessels, heat treatment by steam ejector.
[3] 1 vessel, distillation.
[4] 1 vessel, city of Detroit water supply.

Even though the supervision and control over the conditions under which drinking water is supplied on lake vessels has been limited in the four years since the regulations requiring the treating of lake water aboard became effective, and although it is known that in many instances these apparatuses were carelessly operated and in others not operated at all, nevertheless, there has been a decided drop in the number of typhoid fever cases among Great Lakes seamen hospitalized at United States marine hospitals in these years, as is shown in the following table and the accompanying chart:

Typhoid fever among seamen reported by marine hospitals.

City.	State.	1915		1916		1917		1918		1919		1920		Total.	
		Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Ashtabula	Ohio	1	....	1	....	1	....	1	....	....	....	....	....	4	....
Ashland	Wisconsin	....	....	1	....	1	....	1	....	1	....	....	....	4	....
Bay City	Michigan	....	....	1	....	....	....	....	....	....	....	....	....	1	....
Buffalo	New York	12	....	10	....	12	2	6	1	2	....	5	....	47	3
Cleveland	Ohio	10	....	4	1	4	1	4	....	3	....	2	....	27	2
Chicago	Illinois	6	....	13	....	1	....	4	....	....	....	2	....	26	....
Detroit	Michigan	12	....	14	....	8	....	10	....	12	2	....	....	56	2
Duluth	Minnesota	1	....	....	....	....	....	....	....	....	....	2	....	3	....
Erie	Pennsylvania	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Green Bay	Wisconsin	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Ludington	Michigan	1	....	....	....	2	....	3	1	....	....	....	....	6	1
Manitowoc	do	2	....	6	....	4	1	1	....	1	....	2	....	16	1
Milwaukee	Wisconsin	10	....	10	....	5	1	....	....	1	....	5	....	31	1
Port Huron	Michigan	....	....	....	....	2	....	....	....	....	....	....	....	2	....
Sandusky	Ohio	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Saginaw	Michigan	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Sault Ste. Marie	do	4	....	7	....	9	1	6	....	2	....	2	....	30	1
Superior	Wisconsin	1	....	3	....	....	....	3	....	2	....	....	....	9	....
Toledo	Ohio	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Total		60	....	70	1	49	6	39	2	24	2	20	....	262	11

It is undoubtedly true that the excellent work of such bodies as the Lake Carrier's Association welfare committee and the general publicity given to the danger in connection with the drinking of untreated lake water on vessels had their influence in the reduction of these cases of typhoid fever among seamen, but at the same time, following, as it did, promptly after the installation of treatment apparatus on 65.2 per cent of all the American vessels plying on these lakes, the influence and effectiveness of the Federal regulations in this reduction is plainly apparent.

Prior to 1917, when the Federal laws were enacted, regulating the use of drinking water supplied passengers and crews on Great Lakes vessels, the number of typhoid fever cases among seamen hospitalized at United States marine hospitals in the lake district increased year by year, more or less in accordance with the development of the merchant marine. In 1875 there were 27 cases so hospitalized, with 5 deaths. The number of cases increased gradually year by year, until in 1890, 119 cases, with 8 deaths were reported during that year. For the decade, 1890–1900, inclusive, there was an average of 102 cases, with 9 deaths among Great Lakes seamen. In the next five years, 1901–1905, the average was 156 cases and 11 deaths. The years 1903 and 1904, respectively, were especially heavy typhoid years, 185 cases with 17 deaths and 174 cases with 11 deaths being reported for these respective years.

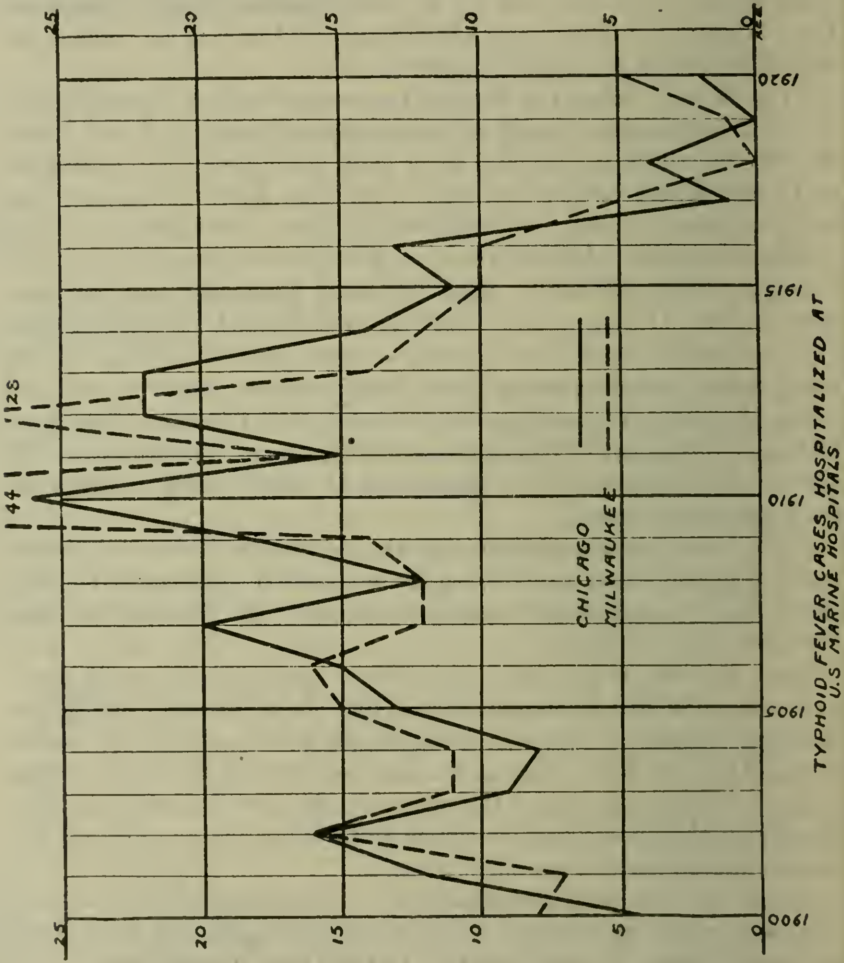
In 1913 and 1914 the epidemics on the steamships *Rochester*, *Huron*, and *Gopher* occurred, and during these years the peak in the typhoid fever curve was probably reached, although the complete returns have not been tabulated.

Since 1917 the drop in the typhoid fever rate has been very marked, as is shown in the accompanying graph. It is not improbable that the large number of typhoid inoculations given seamen who served in the Army or Navy during the war contributed to this reduction in cases; in fact, the rise in the curve for the period 1919–20 is quite significant that there was some such influencing factor affecting this disease during the two previous years.

However, it is very significant and encouraging to note that in 1920 there were fewer cases of typhoid fever among seamen received at United States marine hospitals in the Great Lakes district than there were in 1875, while the shipping on these inland waters was in its infancy.

The Chicago and Milwaukee curves shown for the 21 years, 1900 to 1920, inclusive, are interesting as illustrating the wide and abrupt fluctuations in the typhoid-fever cases reported during the years 1900 to 1916, and the reduction in cases since water treatment apparatuses were installed on vessels. The rise in the curve representing the 1920 typhoid-fever cases is also significant.

Of the 132 cases of typhoid fever reported from members of the crew of 102 different vessels, by the United States marine hospitals in the Great Lakes district, since the opening of the 1917 navigation season, information is available relative to the treatment of the drinking-water supply on vessels from among whose crews 112 of these cases are registered. The following table gives the number of typhoid-fever cases reported during these years and the source or treatment of the water supply used aboard the vessels:



TYPHOID FEVER CASES HOSPITALIZED AT U.S MARINE HOSPITALS

Fig. 7.

Type of vessel and treatment.	1917	1918	1919	1920	Total.
Freight:					
Still	25	24	9	13	71
Lake	2	2		2	6
Passenger:					
R. U. V	8	1	2	1	12
Still	2	2	1		5
St. ejector	1				1
City water	1		1		2
Car ferry:					
Still		2		2	4
Lake	3	1			4
United States Government: [1]					
Lighthouse tender	1			1	2
Dredge	1	2			3
Navy			2		2
Unknown	5	5	9	1	20
Total	49	39	24	20	132

[1] United States Government vessels, water either obtained ashore or taken direct from lakes.

In the year 1917 two cases of typhoid fever were reported from the same vessel, in three instances—twice from freighters and once from a passenger vessel—all having treatment apparatus aboard for sterilizing drinking water. Since that year, there has been a repetition of cases among seamen on no freight or passenger vessels on which the water was treated aboard. In 1918 a car ferry having a still aboard for distilling drinking water had two cases of typhoid fever from among members of its crew, while in 1919 a Navy vessel and a privately owned dredge had two cases each among their respective crews. No repeated cases were reported in 1920. In contrast to this record of the last three years, that of 1915 is cited, when two freighters, a tug and a car ferry, had two cases of typhoid fever each among members of their respective crews, while one Navy vessel had four such cases.

In the four years, 1917 to 1920, inclusive, eight freighters, four passenger vessels, and two car ferries, having treatment apparatus aboard for drinking water, had two cases of typhoid fever each among members of their crews. Two cases have also been reported during these four years from a passenger vessel using city water for drinking purposes, as well as the Navy vessel and dredge mentioned above.

In order to appreciate the relative importance of typhoid fever among seamen in connection with the public health, it is necessary to know something of the number of seamen employed on the Great Lakes and also the number of passengers traveling on lake vessels. It must always be borne in mind, in referring to the records of typhoid fever among seamen as reported by marine hospitals, that many of the seamen with families living in the Great Lakes district do not go to these hospitals for treatment.

The average size crew on the lake bulk freighters is about 30 men, on the car ferries, including "blockers," from 40 to 50 men, and on the barges from 8 to 10 men. The turnover in labor among Great Lakes seamen in a season is about 20 per cent. Using these figures as a basis, there are about 18,000 seamen employed on the lakes each season in freight traffic. The average navigating season on these lakes is from March 15 to December, or 240 days.

The seamen employed on American passenger vessels plying the Great Lakes in a season, assuming a 20 per cent turnover in labor, is estimated at 5,000. The navigation season for passenger service is quite variable, depending on the season and the traffic catered to. Some few vessels of this class operate all year round, others at regular seasons from May 15 to November 15, while those vessels in excursion service run during the two or three summer months only.

In 1920 the number of passages taken on the large vessels of the Great Lakes was about 13,870,000. It is believed that 16,000,000 would be a conservative estimate if the passages taken on all ferry and excursion vessels were added to this figure. About 9,500,000 one-way passages taken on ferries across the river at Detroit are included in the 1920 figures given above, on which vessels no water was supplied for drinking, and which of course should not be considered in connection with the control of water supplies on ships.

Of the 4,370,000 passages known to have been taken on Great Lakes vessels last season, 2,450,000 were on ships supplied with water treated aboard for drinking and cooking purposes, while 1,920,000 were on vessels for which this water supply was obtained ashore.

On April 15, 1921, regulations relative to water furnished for drinking and culinary purposes on vessels operating in interstate traffic or between foreign ports on or adjacent to the frontiers of the United States and adjacent ports in the United States became effective. These regulations are quite similar to those effective for Great Lakes shipping in 1917, but certificates of inspection are required for the water system aboard vessels as well as for the sources of supply ashore. Favorable certificates of inspection will not be issued for a vessel unless all by-passes around water treatment apparatus and cross connections between the drinking water supply system and any other water system on the ship are removed. A physical break in the line, made by removing a short section of pipe and plugging the two ends, is being insisted on in the Great Lakes district for elimination of by-pass and cross-connection piping on ships. It is being recommended that the pipes in the engine room and throughout the ship through which the drinking water is supplied be painted white to distinguish them from all other piping; and also that the section removed from the by-pass line be painted red and mounted on the wall or on a special panel against a white background, so that it will be conveniently available for use in emergencies, but always a reminder that its use is dangerous. Emergency measures for sterilizing all water used for drinking purposes while the by-passes are in operation during emergencies must be taken and a full report of the use of the by-pass and precautionary measures must be reported to the headquarters of the Great Lakes sanitary district. A record must be kept in the ship's log as to the time and location in the lakes at which the drinking water supply tanks were filled. Lead piping in the drinking water distributing system is forbidden because of the number of ships on which distilled water is provided. Water other than that certified for use for drinking and culinary purposes is not permitted in the galley.

Where drinking water is supplied vessels from a source ashore, it is being required that a separate hose or pails be used for delivering this water to the ship. If two kinds of water, one from the harbor for fire purposes and the other city water, are available at the wharf at which the vessel docks, it is being insisted on that the hydrant, from which the ship's drinking water is obtained, be painted white and properly posted with a sign. A recommendation is also made that the other hydrants on the wharf at which the harbor water may be obtained be painted red, as a precautionary measure against their use for supplying drinking water.

The Canadian authorities have adopted practically in their entirety the United States regulations, effective in 1918, relative to drinking water on vessels operating on the Great Lakes and inland waters between Canadian ports and ports in the United States. The following table of Canadian vessels was compiled from the 1920 directory of the Great Lakes Ship Master's Association and includes vessels operating on the St. Lawrence River and canals, as well as on the Great Lakes:

Type of vessel.	300 gross tonnage or under.	Over 300 gross tonnage.	Total.
Passenger	62	71	133
Freight	11	121	132
Barges	38	80	118
Carferries		10	10
Total	111	282	393

For exercising supervision and control over the water supply on Great Lakes vessels this season, the Great Lakes sanitary district has enlisted the cooperation of the shipping interests and the local health authorities. At Chicago where the headquarters for this district are located at United States Marine Hospital No. 5, a water laboratory has been equipped, and an inspector takes samples of water from the ships at dock each day. By arrangement with the city health departments at Buffalo, Chicago, Cleveland, Detroit, and Milwaukee, samples will be taken from the passenger vessels calling at these ports, on two or three days each week by a sanitary inspector and analyzed at the city laboratories. It is hoped that similar arrangements can be made for Toledo, Ohio, and Duluth, Minn. Weekly reports of the results of these analyses will be mailed to the headquarters of the Great Lakes sanitary district for record and each month the shipping companies will be informed of the results of analyses of samples of water taken from their respective vessels. In this way, it is believed that a willing spirit of cooperation between all parties concerned in the interest and health of the traveling public will be developed.

The report of the committee on certification of interstate carrier waters was read and discussed, and approved with modifications as follows:

REPORT OF COMMITTEE ON CERTIFICATION OF INTERSTATE CARRIER WATERS.

In the light of experience gained in the administration of the cooperative certification policy between State health departments and the United States Public Health Service during the past two years, in which period various related matters have come up for consideration, it is believed advisable that certain action be taken to clarify the principles of this policy and to make this policy more effective. It is, therefore, recommended:

1. If a water supply has been found unsafe by a State health department and disapproved to the city and improvements recommended by the department to insure the safety of the supply, the use of such water supply by a common carrier for drinking and culinary purposes in interstate traffic should be prohibited.
2. Placards stating that the use of an unsatisfactory water is forbidden should specify the governmental body condemning the supply, either the State health department alone, or in cooperation with the United States Public Health Service as the State may deem advisable, and should be posted over taps at stations through the State health department.
3. The policy concerning certification of vessel waters and vessel water systems should be adopted.
4. The methods of handling water from the supply to the delivery to the consumer on common carriers in interstate traffic should be supervised through the cooperation of the State health departments and the United States Public Health Service.
5. A committee of this conference should be appointed to consider various matters relating to this policy as they come up in the future.

Afternoon Session, June 2, 1921.

The conference reconvened at 1.30 p. m., Mr. Whittaker presiding.

A nominating committee was appointed consisting of Mr. Gage, chairman, Mr. Tisdale and Mr. Pincus.

Mr. C. A. Emerson, jr., submitted the following report:

REPORT OF COMMITTEE ON MILK SUPPLIES.

Those interested in the milk problem of to-day frequently inquire why the sanitary engineering profession has not taken a more direct part in the solution of the many perplexities of an engineering nature which surround the production, treatment and distribution of milk and milk products. Doubtless no other problem of health and convenience presents so large a field for the varied activities of the engineering profession.

Those already devoting their attention to this work are the agriculturist, the veterinarian, the bacteriologist, the chemist, the structural, mechanical, and refrigerating engineer, the health officer, the physician, the nutritionist, and the financier. All of these are assisting in the solution of some particular phase of the problem. Someone should correlate the facts at hand, anticipate the needs of the future, and act as a clearing house for those already engaged in the milk business—and who is better fitted for this duty than the sanitary engineer?

Have we to-day the best design for a dairy barn, silo, stable, stanchion, milk pail, milk can, milking machine, milk pipe, milk bottle, bottle washer, can washer, and delivery wagon? Are we properly constructing, screening, ventilating and lighting our milk plants? What is clean, safe milk? What does it cost and what should it cost to produce, transport, pasteurize, cool, bottle and deliver a quart of milk? Many of these questions are now before us unanswered. The committee feels, however, that our present consideration should deal with fundamentals upon which may be built a future structure containing more detail.

There are regulations which are national in application, others should be assumed by the State, and others are of a purely local nature. The regulations of none are well established at this time. We are convinced that regulations of any kind must begin with present conditions and build a progressive policy, keeping in mind the finances of the problem as well as the quality of the supply. We are dealing with a food which is almost universal in use and national efforts are being made both by the producer and the distributor to materially increase milk consumption.

Regulations necessary to care for general market conditions may be grouped as follows:

First. Milk shall have food value to be useful.

Second. Milk shall be safe to prevent disease.

Third. Milk shall be clean to observe decency.

Fourth. Milk shall have keeping quality to be satisfactory.

Fifth. Milk shall be fair in price to assure production and consumption.

There are five distinct advancements which this committee wishes to recognize:

First. The accredited herd plan, as promoted by the Bureau of Animal Industry, United States Department of Agriculture, and similar bureaus in 46 States. By this plan we have herds known to be free from bovine tuberculosis, and thus a raw milk is obtained which can not transmit bovine tuberculosis to the consumer.

Second. Certified milk, when it is the product of dairies operated in accordance with the "Methods and standards for the production and distribution of certified milk" adopted by the American Association of Medical Milk Commissions. A few boards of health, corporations, and individuals are now certifying milk. Certified milk should conform to standards which are uniform throughout the Nation. The term, certified milk, should be limited to milk which has been certified by a medical-milk commission operating in accordance with the regulations of the American Association of Medical Milk Commissions.

Third. Standard methods for the bacteriological examination of milk, as adopted by the laboratory section of the American Public Health Association. These methods have been sanctioned by committees of the laboratory section of the American Public Health Association, American Dairy Science Association, International Association of Dairy and Milk Inspectors, and members of committees from the Society of American Bacteriologists and American Association of Medical Milk Commissions. The use of these methods for the bacteriological examination of milk gives comparable results, and this procedure should receive universal support and be national in character.

Fourth. Pasteurized milk is defined by the United States Department of Agriculture, in Food Inspection Decision No. 178, as "milk that has been subjected to a temperature not lower than 145° F. for not less than 30 minutes. Unless it is bottled hot, it is promptly cooled to 50° F. or lower."

The above definition was approved by the Association of American Dairy, Food, and Drug Officials and by the Association of Official Agricultural Chemists.

Practically the same definition of pasteurized milk is given by the committee on milk supply of the sanitary engineering section, American Public Health Association, which says: "The process of pasteurizing milk for human consumption should consist of subjecting the milk to a temperature not lower than 145° F. for not less than 30 minutes."

The definition of pasteurized milk should be national in character as far as heating and holding is concerned. Cooling affects the keeping quality rather than safety, and possibly the temperature to which milk should be cooled should not be included in the definition of the process of pasteurizing.

Fifth. At the present time various terms are used throughout the country to designate the different grades or kinds of milk being sold. Often an identical grade is described by different terms. A system of grading established and defined by the State or Nation would do much to protect the consumer against fraud, allow the consumer to purchase the kind of milk desired, and bring about a financial stimulus essential to the production of clean milk. The number of grades required would not exceed four or five in any case.

Your committee considers it the duty of the health official to designate the quality of milk a dairy farm should produce and permit the dairy interests, as far as possible, to select the methods and equipment necessary to attain such quality. This means that the health official will confine his attention to such methods and equipment as have a direct bearing upon the production of a milk supply free from transmissible disease. The dairy interests are attempting to develop their own supervision over methods and equipment at the dairy farm to such an extent that interference by the health official will be unnecessary, and by this way it is believed that considerable friction which has existed will eventually be overcome.

Consideration of some of the difficulties in regulating the food value of milk is worthy of the attention of this association.

Market conditions now require a milk treatment and delivery expense almost equal to the expense of production. The laws of several States require at least 3.25 per cent fat in the market milk, and a few have permitted the sale of 3 per cent milk when delivered by the producer. The agitation for a low butter fat content has been largely promoted by the producer, because he has found it feasible to breed herds giving milk of a low fat content at probably a less expense to him. But, on the other hand, the consumer desires, and in many cases demands, a milk containing at least 3.5 per cent butter fat. Why then should not the milk produced be nearer to that which is required by the consumer. The State law in many cases prohibits changing the fat content in the milk after delivery from the dairy farm. This is not a vicious practice. If standardization is legalized and the producer encouraged in the production of milk containing at least 3.5 per cent butter fat, it is the belief of the committee that a more just and satisfactory condition will be brought about.

. A motion was made, seconded and approved to adopt the above report.

Mr. H. A. Whittaker presented the following paper:

THE SUPERVISION OF MILK PASTEURIZATION IN MINNESOTA.

The State board of health, in 1917, authorized an investigation of conditions relating to pasteurized milk used for human consumption throughout the State. The division of sanitation was selected to undertake the major part of this investigation because it was equipped with the engineering and laboratory facilities necessary for carrying on such work. At that time there were about 50 pasteurization plants in operation in the State. Milk was labeled and sold as pasteurized milk in all but seven cities with a population of 5,000 or more, and in these cities it represented from 50 to 90 per cent of the entire supply. Investigations were made at 32 plants, and in practically every instance the pasteurization of milk as carried on at that time had little, if any, value from a health point of view. Five plants were found labeling their product "pasteurized milk" when they did not own any pasteurizing apparatus.

The detailed investigation at each pasteurization plant, conducted during this survey, included a study of the building in which the plant was housed; the plant equipment, involving a careful examination for mechanical defects; and the efficiency of the process in accomplishing satisfactory pasteurization of the milk as determined by analytical examinations of the milk before pasteurization and during the various steps in the process. A careful study was also made of the methods of operation in use at each plant. Information was also collected relative to the supervision exercised by local authorities in the various communities in which these plants were located.

The investigation of the buildings in which the various plants were housed revealed the fact that the buildings were improperly planned and constructed for housing pasteurizing apparatus and other milk-plant equipment. Some of these buildings were improperly lighted and ventilated; had floors and walls constructed of material or in such a manner that they could not easily be cleaned; had unsafe or inadequate water supplies; had unsatisfactory sewage and waste disposal facilities; lacked toilet and lavatory facilities, and were not effectively screened against flies.

The study of the pasteurizing apparatus in use at the various plants brought out the fact that much of the equipment was incorrectly designed and constructed for the purpose of pasteurizing milk for human consumption, and that it was oftentimes arranged in an insanitary and impractical way. Many mechanical defects were found in the apparatus which could be eliminated, thereby insuring a safer product from a health point of view. These defects included mechanical difficulties in heating the milk to a proper temperature, in holding it at the required temperature for a sufficient length of time, in preventing the contamination of the treated or partially treated product at some step in the process with raw milk, partially treated milk, or with other contamination introduced from some external source during the treatment or to the finished product.

In addition to the unsatisfactory conditions associated with the housing of these plants and their equipment it was found that many operators did not understand the purpose of pasteurization, the principles involved in the process, or the methods of operating and caring for pasteurizing apparatus. The employees at the plants were not given a medical examination to determine whether they were chronic carriers of infectious diseases.

This investigation revealed the fact that the control of pasteurization, and the subsequent handling of the finished product, was almost negligible at that time; the State had no law or regulation governing pasteurization, and only a few municipalities had local ordinances which gave them authority over the distribution of this class of milk.

To summarize briefly the results of these investigations, it was found that the pasteurization of milk throughout the State, as conducted at that time, meant practically nothing from a health point of view. It was practiced largely to improve the keeping quality of the milk and for advertising purposes. This condition should not be charged entirely against the milk dealers, for the State had not then laid down any requirements for the pasteurization of milk, and only a few municipalities had realized the importance of establishing local control. The continuation of this condition would eventually have resulted in the loss of public confidence in the process as a health measure in the State.

With this information available, the State board of health decided that if the process of pasteurization as applied to milk for human consumption was to have any value as a safeguard against disease, some method of control must be adopted, and as a result the following steps have been taken to improve the unsatisfactory conditions which were found to exist.

In order to establish a uniform requirement for the pasteurization of milk throughout the State, a regulation was passed by the State board of health defining pasteurization and requiring the approval of plans and specifications on all new installations, or changes in existing installations, of pasteurizing apparatus. General requirements governing the construction and operation of pasteurization plants were outlined, which established a uniform basis for the enforcement of this regulation.

The fact that the plant owners and operators did not always understand the purpose of pasteurization as a protection against disease, the principles involved in the process, or the methods of operation and care of their pasteurizing apparatus, demonstrated the need for establishing some course of training for educating these people. Arrangements were made with the division of dairy husbandry of the department of agriculture, University of Minnesota, to give a course for training plant operators, in cooperation with the State board of health.

To further the establishment of local control of pasteurized milk and its subsequent handling in municipalities in the State, a proposed milk ordinance was drafted and approved by all departments of the State government interested in the local control of milk supplies. This ordinance is adaptable to cities in the State not in Class I, which would include all cities except Minneapolis, St. Paul, and Duluth. The requirements of this ordinance governing pasteurization conform with the regulations of the State board of health.

As a result of these efforts to establish supervision of pasteurization in the State, pasteurization plants have been investigated and recommendations made for correcting defects in construction and operation in all plants where it was found to be necessary. These recommendations have been carried out in all plants under the jurisdiction of the State board of health, or the plants have been requested to discontinue labeling their products "pasteurized milk." Follow-up investigations are being made at irregular intervals to determine whether the plants are being operated in a satisfactory manner and to assist the authorities where local control has been established.

Plans of new pasteurization plants are being examined and approved in accordance with the detail procedure established for carrying out the regulations of the State Board of Health.

Provision has been made for the medical examination of employees who are engaged in the pasteurization or bottling of milk, or in the cleaning or sterilizing of milk apparatus and utensils at the plant, in an effort to locate chronic carriers of infectious diseases. This work is done under the direction of the division of preventable diseases of the State board of health.

Short courses for pasteurization plant owners and operators have been given at the University of Minnesota for the past two years. These courses have consisted of lectures, demonstrations, and visits to pasteurization plants, including briefly the study of the process of pasteurization as a health measure, the important essentials in the construction and operation of pasteurizing apparatus, and general practical milk plant problems. These courses have been well attended and have resulted in an apparent improvement in the personnel of pasteurization plants throughout the State.

A campaign has been carried on to encourage municipalities to pass the proposed milk ordinance approved by the various State departments, which establishes local control of the milk supplies under State supervision. Talks and illustrated lectures before interested organizations, and city and village councils, have proved a very effective way of accomplishing results. The results of this work may be understood when it is appreciated that only two cities in the State, exclusive of cities in class I, had effective local supervision when this work began, while at the present time the proposed ordinance has been passed and is in force in 50 per cent of the cities in the State with a population of 5,000 or over (27 over 5,000 population).

The success which has been obtained in Minnesota in the improvement of the pasteurization of milk from a health point of view may be attributed to a number of reasons, the most important of which are: (1) The initial survey which provided information concerning the existing status of pasteurization in Minnesota, and formed an intelligent basis for action, (2) the carefully worked-out plan for correcting the unsatisfactory conditions which were found, and (3) the cooperation which was received from all parties concerned, including municipal officials, local organizations interested in this problem, and the milk dealers.

Mr. J. Frederick Jackson spoke as follows:

STATE CONTROL OF STREAM POLLUTION AND SEWAGE DISPOSAL IN CONNECTICUT.

State control in Connecticut emanates from that authority which is vested in a special commission or some executive department by legislative act and which it may exercise within certain limitations, and the restraint or pollution which proceeds from judicial action in response to claim of invasion of the rights of the individual citizen under common law statutes. Control of the latter class, Connecticut has exercised since about the middle of the nineteenth century. Her statutes have gone farther than the legislation of most States, and decisions of her courts have served as precedents for other States when considering questions of stream pollution.

Control by special legislation has been in force in Connecticut only since 1915, when the present statutes were enacted. These placed the administration with the State department of health and authorized it to investigate pollution of streams, sewerage systems, and sewage and refuse disposal works, and require for the latter efficient operation or order their alteration or replacement, if deemed necessary for the protection of public health. They also required the approval of the department for all plans for new sewerage systems and disposal works before construction. Action by the department was limited to pollution which was prejudicial to public health. In 1917, a later act created an industrial wastes board to cooperate with the department of health in studying the pollution by factory waste.

The area of the State is about 5,000 square miles and drainage basins of the three largest rivers—the Housatonic, Connecticut, and Thames—constitute about 78 per cent of this area. Lakes, swamps, and salt marsh cover about 154 square miles.

Of the 168 towns, 61 are partially or wholly sewered and 19 towns treat their sewage. The method of treatment varies, but intermittent sand filtration is most common.

In investigations of stream pollution, we must consider surface and underground waters; intra and inter state, navigable and non-navigable rivers; streams used as a source of potable supply; streams dedicated to fishing or industrial use. In Connecticut we must also consider the estuaries and waters of Long Island Sound.

Former investigations include a survey several years ago of most of the potable water supplies of the State by Profs. Williston and Smith and a survey by the old State board of health in 1914, by special direction of the general assembly, of most of the important streams of the State. Conditions shown by this last survey were instrumental in securing the passage of the acts of 1915.

Prior to the organization of the present department of health in 1917, there was practically no supervision over sewerage works. Since that time with a limited personnel and appropriation, our efforts have been confined to obtaining a correct list of the sewerage systems and sewage-disposal works existing in the State and to educating those responsible, in some methodical schedule of operation and maintenance. Since the organization of the State department and of the passage of the acts of 1915, 47 approvals have been granted for sewerage works.

The whole question of State control, as we view it in Connecticut, means a campaign in educating the people in the benefits and desirability of properly designed sewerage systems and efficiently operated sewage-disposal works. To convince people, who for years have been using the nearest water course as the natural method of disposing of their wastes, of the necessity of treating their sewage before discharge is a long and often discouraging task and calls for the exercise of great patience, diplomacy, and persistency.

The improvement in the six years that this work has been under way, though much still remains to be accomplished, is distinctly encouraging. There has, as yet, been no test case of the authority granted to the department under the statutes. There is a wholesome respect as a result of the decisions rendered against the cities of Waterbury, New Britain, and Danbury under the common law which leads most of the municipalities, who are violators, to adopt a receptive attitude, and makes them willing to at least listen to suggestions toward removing their pollution from the streams.

For over 10 years there has been a very strong public sentiment in the State against the continuance of the present pollution and it showed itself very strongly in 1915 when the present statutes were enacted. This year it was particularly strong and an act to eliminate all stream pollution by industrial wastes before 1926 was proposed. This bill was supported largely by the shellfish and finny fish industries who have seen the oyster industry in the harbors along the coast and Long Island Sound and the shad and salmon fishing in the Thames, Connecticut, Housatonic, and other streams disappear.

While control of stream pollution is under two bodies—the Department of Health and Industrial Wastes Board—actually they function as one. The method of operation is as follows: All complaints are investigated by the commissioner of health who acts as chairman of the joint board. If investigation shows pollution is caused by industrial wastes and is sufficiently important, then the problem is referred to the Industrial Wastes Board for complete investigation and report. The Industrial Wastes Board has no authority to issue orders to stop pollution, and action by the department of health, as has been stated before, is limited to pollution prejudicial to public health.

The work of the industrial wastes board has been confined to an intensive study of the Naugatuck and Hockanum Rivers, silk-mill wastes at South Manchester, iron wastes at New Britain, and wastes from wood distillation at East Canaan, together with preliminary surveys of several other streams in the State. The results of these investigations were quite interesting. Time does not permit us to discuss them fully, but some of the more important were: Limits of impurity; effect of copper, zinc, and iron waste on bacteria; failure of criteria of dissolved oxygen and dissolved oxygen demand in presence of these wastes; treatment of wastes at source *v.* treatment at one disposal works; limits of equalization of flow from storage reservoirs; limits of theory of stream flow per contributing population.

There are 19 municipal disposal plants in the State—2 digestion (followed by sand filtration), 4 Imhoff tank and disinfection, 2 septic tanks, 1 sand filtration and broad irrigation, and the other 10 some form of sand filtration. At practically all of these, with the exception of the three mentioned below, operation is not satisfactory. Of the municipalities located on the sound, Greenwich treats its sewage by Imhoff tanks; Stamford has a plant practically complete for treating its sewage the same way; Bridgeport is installing a screening plant to take care of the sewage from the west side of the city and later expects to install another screening plant to take care of that from the east side; New Haven disposes of its sewage in the harbor untreated, but is considering treating it by the Miles acid process; New London, with the great volume of water in its harbor, disposes from submerged outlets 800 feet off shore; the remainder of the small towns, such as Westport and Norwalk, which have sewerage systems, dispose of their sewage untreated either into the river or harbor.

Of the inland cities on the larger rivers, Hartford on the Connecticut, Willimantic on the Willimantic, Putnam on the Quinnebaug, Torrington, Thomaston, Waterbury, Naugatuck, Ansonia on the Naugatuck, and New Milford, Birmingham, Shelton, and Derby on the Housatonic, discharge their sewage untreated into the streams. State institutions, where they are not connected to the public sewer system, and with the exception of the State Hospital for the Insane at Norwich on the Thames River, and the State's prison at Wethersfield on the Connecticut, all have some method of treatment though in the majority of cases, the operation has been so neglected that little or no purification is effected. At the 36 shore resorts scattered along the edge of the Sound no attempt is made to treat the sewage, except at Sound Beach, Woodmont, and Groton Long Point. Disposal in general is by means of outside privies or where water-flush toilets are installed, leaching cesspools, or septic tanks. At the 65 camps of more or less permanent character in the State, with the exception of one or two, the method of disposal is by outside privies.

Connecticut has probably three of the oldest and most successful intermittent sand filtration plants in the country, those at Meriden, Bristol, and Danbury. The plant at Meriden was built in 1892 the city acquiring about 145 acres of land for this purpose. It consists of 11 acres of beds for treatment of dry-weather flow with two additional to take care of the storm water. The site is particularly favorable, the sand deposit being over 30 feet deep and ground water level 16 feet from the surface. Average volume of sewage treated in 1920 was 3.9 million gallons and operating cost $9.17 per million gallons. The plant in Bristol was built in 1895. The city owns 83½ acres and there are about 11 acres of built-up beds. They are treating about 2 million gallons per day at a cost of about $14 per million gallons. The plant in Danbury was built in 1897 and consists of 10 acres of sand beds and 10 acres of broad irrigation. The volume of sewage treated is about 3 million gallons per day and cost $5.61 per million gallons.

Meriden and Bristol showed unusual foresight in providing ample areas of land and are insured against any trouble for many years to come. The effluents from all three plants are good and per cent removal uniformly high. Bristol had some trouble from clogging of the beds which they attributed to iron wastes, but which was more likely due to overloading and to practice of plowing beds deeply which caused the overturned surface mat to form an impermeable strata about 12 to 16 inches below the surface.

The experience with these plants is very different from that at New Britain where iron pickling liquors have so affected the beds, the area of which was admittedly too small and their character unsuitable so as almost to put them out of use, and at South Manchester where, though the sand was satisfactory, the area was not nearly large enough, and wastes from silk mills have completely clogged the beds. At New Britain the dosage was about 143,000 gallons per acre per day and South Manchester 350,000 gallons.

In Connecticut no rivers grossly polluted are used as a source of water supply. Present statutes give sufficient authority to the department to protect streams used as a source of water supply and control of these is tolerably easy where minor nuisances occur. We have no cases where streams used for disposal become entirely dry at certain seasons of the year, though in many of them the flow is greatly diminished. The stream pollution with which we are concerned at present is that affecting fishing, boating, bathing and pasturing of cattle. The control of this is difficult where proof of its being detrimental to public health is required.

The need of some change in the limitation of bond issues by the general assembly is very apparent and any great improvement in many of the towns will be delayed because they have already reached their limit of bonded indebtedness. The writer had occasion in appearing before the committee on finance to urge that in considering requests by towns to use bonds, sewerage systems should be placed in the same class as lighting, power, and water companies, but this argument did not seem to impress the committee very much.

One feature of our work that is interesting is the greater success in getting improvements made when dealing with corporations and individuals than when dealing with municipalities. In general, there appears to be less initiative and greater tendency to delay improvements on the part of the municipalities. They are rather content to let things rest as they are, conduct no research, nor make any plans for future development.

That the common law gives all authority necessary to control the pollution of streams is shown in the cases of Morgan *v.* Danbury, Platt Bros. *v.* Waterbury, Nolan *v.* New Britain. It places, however, the burden of proof and the expense of court procedure upon the individual riparian owner. Control by the State is at present limited to pollution which can be shown to be prejudicial to public health; though in case of water and ice supplies, considerable latitude is given to local health officers and the State department of health to control nuisances.

As we see it in Connecticut, power should be granted the State department to control violations against public welfare as well as public health. A system of reporting similar to that required from public utilities should be put in force and authorities should be educated to the fact that sewage disposal works must have just as careful operation and supervision as water works or other public utilities. Whether efficient supervision can be maintained by correspondence is doubtful. On the other hand, to exercise a close supervision and compel efficient operation with authority as at present would require so large an organization and expense as to be prohibitive. The retention of designers of plants as consulting engineers by municipalities would be desirable, but its recommendation by a State department is likely to raise suspicion of collusion. One carefully prepared and ably prosecuted case of violation will accomplish more than any amount of correspondence and inspection. Every riparian owner should be supported strongly when his property is affected by pollution, and if this is done their interest will be stimulated and their support for constructive legislation assured.

There have been two contradictory tendencies evident lately; one toward a general letting down of restrictions and regulations safeguarding health, coming from those who from their experience with the many governmental restrictions during the war now resent any attempt to control either their corporate or individual action; the other toward continuing and in some cases extending the supervision of the State over matters of this kind.

In Rhode Island the latter manifested itself in the passage of a rather drastic act concerning the pollution of rivers by industrial wastes, the nucleus of which was in defining pollution as that which is deleterious to fish and plant life. In Connecticut a similar bill had very strong support, but is was so strongly opposed by manufacturers and municipalities that it failed in committee. The committee reported that they were unable to frame any bill which would be fair to the manufacturers, the municipalities, and the State at large.

However, it is easy to discern a definite attitude toward stricter standards for effluent sand trade wastes. This should be considered by engineers engaged in health work and study and provision made to meet it. In this connection we might to-day very well ask ourselves: (1) Have we established satisfactory criteria for practical use, or have we been misdirecting our efforts in setting up limits and standards difficult, if not impossible, of application, and so indefinite in their determinations of the degree of pollution as to be practically useless in administering State control over stream pollution?

The success of control by a State department or commission depends on personnel and appropriation, natural features of the State, such as streams, lakes, etc., its area, character of its industries, whether it is a recently settled State or one which has been settled for a long time, and general attitude of mind of its citizens. The advisability of setting strict standards depends largely upon the value of the industries affected, and whether we are trying to protect the people against inconvenience from nuisance, or safeguarding public health, which must be protected at any cost. In considering pollution we must also take into account the accessibility of the stream to large centers of population and its effect upon their health when used for camps and recreation purposes.

For example, certain portions of our coast particularly suitable for sanitariums for crippled children must be strictly supervised. New industries should be forbidden to locate on streams suitable for camping and still containing fish life. Established industries on such streams should be required to treat their wastes so that they are not objectionable.

Finally, what we need in actual practice to-day is the simplest and least costly method of disposal for (1) dwellings, institutions, and camps not accessible to sewerage systems, and where a sufficiently large body of water for dilution is available or where the soil conditions are satisfactory; (2) most economical method of disposal for municipalities with existing sewerage systems, convenient to large bodies of water; (3) most economical disposal for municipalities with existing sewerage system, located on small bodies of water or with subsoil not suitable for disposal on land; (4) shore resorts with sewerage systems; (5) shore resorts without sewerage systems.

In this study each city and each locality in the State should be considered as a separate problem. Connecticut has its own particular problems and their treatment and solution may be such as would not be advisable in other sections of the country.

Mr. H. E. Miller, representing Mr. Ehlers, presented the following report.

PROGRESS REPORT OF COMMITTEE ON SEWAGE DISPOSAL AND STREAM POLLUTION.

INTRODUCTION.

By reason of the lateness of replies to questionnaires reaching the chairman of your committee and the limited time in which to study the various laws and regulations, our report to the association at this time must be confined to a brief summary of the data at hand.

RÉSUMÉ.

For your information we wish first to call your attention to the questionnaire form prepared by your committee and forwarded to the sanitary engineer of each State through Mr. I. W. Mendelsohn, district engineer, United States Public Health Service, Washington, D. C., and corresponding secretary for the conference of State Sanitary Engineers.

Considerable study was given to the preparation of a questionnaire with the object of securing pertinent information on the present status of State control of sewage and stream pollution, in condensed form, and still provide sufficient evidence for a comprehensive digest. Copies of laws and regulations were also requested, principally to determine what State agency is given jurisdiction with or without limitations and what machinery is provided.

Replies to the questionnaire were received from the following thirty-three States: Alabama, Arizona, California, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Montana, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, and West Virginia.

A résumé of these replies indicates that:

1. The following States have laws or some form of State board of health regulations relating to sewerage and sewage disposal:

Laws: California, Connecticut, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Montana, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, Texas, Vermont, and West Virginia.

No laws: Alabama, Arizona, Delaware, Florida, Georgia, Missouri, South Carolina, South Dakota, Tennessee, and Virginia.

2. From this list it is noted that 23 out of the 33 States listed have laws or regulations.

3. Practically many of the existing laws and regulations are not entirely satisfactory.

4. A large percentage of statutes are behind prevailing public opinion.

5. Twenty-one States of the 23 that have laws or regulations require examination of plans and 19 require that permits be issued before construction work can be started on sewer systems or disposal plants.

6. Specifications of the engineering division of each State listed, requiring submission of plans, are noted to be very general and intended only to be suggestive, leaving matters largely to the judgment of designing engineers.

7. Practically all engineering divisions depend on engineers' visits, inspections, and newspaper reports to be made aware of new projects.

8. Every State listed uses and prefers sanitary engineers operating from one central office, with the exception of Tennessee and Maryland.

9. Engineering divisions of the States listed make special efforts to stimulate the building of sewerage systems and sewage disposal plants excepting where lack of personnel prohibits.

10. The following list of States from those replying are found to be empowered to order improvements: Alabama, California, Kansas, Kentucky, Maryland, Mississippi, Montana, New Mexico, North Carolina, North Dakota, Oklahoma, Ohio, and South Carolina.

11. Very limited work has been undertaken to study the pollution of streams.

Among those recording investigations along this line are California, Connecticut, Indiana, Louisiana, Michigan, Missouri, Minnesota, Montana, New Jersey, New Mexico, Ohio, Pennsylvania, and Rhode Island.

12. Trade wastes are shown to vary in the different States. Progress in the handling of troublesome wastes is noted to be retarded, largely on account of funds and personnel.

13. States recording treatment of typical trade wastes are as follows:

(1) Ohio.—Pickling liquor producing sugar, copperas without liquid wastes.

(2) Louisiana.—Sugar factory wastes, dry broad irrigation.

(3) Illinois and Texas.—Being conducted on corn products wastes, not described.

(4) Kansas.—Oil refineries—waste held in reservoir and discharged according to flow of stream to give maximum dilution.

(5) West Virginia.—Tanneries by series of sedimentation basins, inefficient operation.

(6) Minnesota.—Dairy wastes by settling tanks.

(7) Connecticut.—Tannery wastes have screening, door-thickener, lagoon, dosing chamber, and sand bed. Just installed; good results anticipated.

(8) California.—Fruit and vegetable cannery waste by settling or fine screening, with final disposal by spreading on sandy land.

(9) Virginia.—Tannery wastes. Refers to report of Hommon on Luray tannery plant.

14. No definite policy seems to be adopted by any State regarding method of handling or disposal of troublesome wastes, although decided progress is being made in this field .of controlling stream pollution.

15. Your committee further notes that where adequate laws exist and commensurate machinery is supplied, very satisfactory results are exhibited.

In some of the States where trade wastes are a considerable problem there are no facilities for making the desirable studies. The United States Health Service could render a valuable service if it could assist these States in solving this problem. The investigations that have been under way by the United States Public Health Service have been of great value, and should be extended in scope.

A motion was made, seconded, and adopted to accept this report as a progress report.

Mr. Allen spoke on "Ratproofing from an engineer's point of view."

Mr. E. H. Gage, representing Mr. Merser, submitted the following report:

COMMITTEE REPORT ON MOSQUITO CONTROL.

Following the annual meeting in Washington last year a committee was appointed to prepare a report on mosquito control. As a first step the committee decided to secure information from all the States by means of a questionnaire covering the following phases of the subject: (1) State organization, (2) appropriations, with amounts expended in municipalities and in rural districts, (3) laws and regulations, (4) morbidity reports and (5) remarks concerning the control methods which have proved most satisfactory.

Replies have been received from 36 of the 48 States or 75 per cent, which is a very gratifying response.

The information obtained has been summarized and is presented in the tables which follow, with explanatory notes where necessary.

Table I.

State.	Control work.		Special laws or regulations.	Reporting of malaria.			
	Yes or No.	Primary objects.		To State board.	Time allowed.	Reliability.	Approximate per cent.
Alabama	Yes	Malaria	Yes	Yes	Week	Doubtful	25
Arizona	No			Yes	Month	Poor	
Arkansas	Yes	Malaria	Yes	Yes	Week	Poor	Less 10.
California	Yes	Malaria	Yes	Yes		Poor	10
Connecticut	Yes	Mosquito	Yes	Yes		Poor	
Delaware	No			Yes	Day	Poor	Low.
Florida	Yes	Malaria	No	Yes	6 hours	Poor	10
Georgia	Yes	Malaria	No	Yes	Week	Poor	Less 10.
Idaho	No						
Illinois	No		No	Yes	Day	Poor	
Indiana	No			Yes			
Kansas	No						
Kentucky	Yes	Mosquito	No	Yes	Day	Poor	30-50
Louisiana	Yes	Malaria	No	Yes	*	Poor	*
Maryland	No			Yes	Day		
Michigan	No			No			
Minnesota	No		No	No			
Mississippi	Yes	Malaria	Yes	Yes	Month	Fair	50-75
Missouri	No		No	Yes	Week	Poor	
Montana	No			Yes			
New Hampshire	No		No	Yes		Good	
New Jersey	Yes	Mosquito	Yes	Yes			
New Mexico	Yes	Mosquito	No	Yes	Day	Poor	
North Carolina	Yes	Malaria	No	No			
North Dakota	No						
Ohio	No		No	Yes	2 days	Good	
Oklahoma	No						
Pennsylvania	Yes	Mosquito	Yes	Yes	*		*
Rhode Island	Yes	Mosquito	No	Yes			
South Carolina	Yes	Malaria	Yes	Yes	Month	Poor	
South Dakota	No						
Tennessee	Yes	Malaria	No	Yes			
Texas	Yes	Malaria	No	Just started.	Month	Poor	
Virginia	Yes	Malaria	No	Yes	Month	Poor	
West Virginia	No						
Wisconsin	No						

*Number not known.

From the above tables it is noted that mosquito control is being done in 18 of the 36 States, and in all of these except Connecticut, Kentucky, New Mexico, Rhode Island, New Jersey, and Pennsylvania the primary object is the reduction of malaria. In four of the States the work is not under the supervision of the State board of health but is being carried on by other departments as follows:

Connecticut: By the State agricultural station.

New Jersey: By State department of conservation and development.

Rhode Island: By local authorities only.

California: By the university agricultural experimental station.

In a number of States, Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia, the United States Public Health Service and International Health Board, or both, have entered into cooperative arrangements with the State boards and have furnished funds or personnel. Similar arrangements are now being made in the State of Missouri.

LAWS AND REGULATIONS.

Concerning special laws and regulations pertaining to mosquito control and particularly State supervision of impounded water, reclamation of wet lands, irrigation projects, and stream control, replies are summarized as follows:

Alabama.—Impounded water: Permit must be granted to impound any water. The law provides that when a dam is to be built a jury of 12 men is selected to fix the damages to the land and to determine whether impounding of water will or will not be injurious to the public health. The usual procedure is for the jury to call on the county board of health, which in turn calls on the State board to send an engineer for the purpose of making an investigation and to keep in touch with the proceedings until the jury report is made and confirmed by the court. So far the law has been very effective.

The State highway department has included in specifications for State aid and Federal aid roads a clause requiring the contractor to drain or fill borrow pits which otherwise would constitute mosquito nuisances.

Arkansas.—The State highway department has special regulations in connection with drainage along improved highways.

California.—Drainage district: An act approved 1915, providing that districts having populations of 100 or more may be created for the abatement of mosquitoes. Under this act districts, including incorporated and unincorporated property or portions of both where mosquito control is desired, authorizes the taxation of landowners in that district to the extent (if necessary) of 10 cents on $100. The funds thus collected are used for the salary of an expert placed in charge of the work, labor, utensils, and permanent control measures.

Connecticut.—An act approved 1917, providing that director of the State agricultural experiment station may make rules and orders concerning elimination of mosquitoes and mosquito breeding places, for the appointment of deputies to supervise the work. This act was amended in 1919 as follows: Whenever any swamp, marsh, or other land has been drained, property owners shall keep same in repair and free from obstructions and construct or repair tide gates or otherwise treat such areas so as to make the work effective. The cost of maintenance or treatment, not exceeding $1 per acre per year, shall be paid by the State, and the town, city, or borough within which such place or area is located shall reimburse the State for three-fourths of the amount so expended. The act further provides for the appointment of one or more deputies to supervise the work, that the expenses for the supervision and inspection shall be included in computing the cost of the work, but the actual cost of making preliminary inspections and surveys and for the supervision and inspection of the construction and maintenance by the said director or his deputies shall be borne wholly by the State and paid from the funds appropriated for the purpose. It is also provided that any person obstructing the work of examining, surveying, or ditching or otherwise treating such mosquito-breeding areas, or obstructing any ditch, canal, or drain, or the natural outlet of any marsh-forming, mosquito-breeding area shall be fined not more than $100 or imprisoned not more than 90 days or both.

Florida.—The State road department has a regulation relative to drainage and borrow pits along highways. The standard railway sanitary code also has some antimosquito provisions. In addition, a general statute has provisions concerning the sinking of wells for drainage purposes, and there is a drainage law empowering districts to drain large areas of land.

Mississippi.—Regulations providing that it shall be unlawful to maintain or permit in any of the counties in which the antimalaria work is being done by the State board of health or cooperative agencies, any standing or flowing water in which mosquitoes breed or are likely to breed unless such collections of water are treated by an approved method so as to effectively prevent such breeding.

South Carolina.—Impounded water: Mosquito breeding in impounded waters can be declared a nuisance and dam ordered removed. (NOTE.—The questionnaire does not state whether this law has ever been enforced.)

Virginia.—No special laws, but there have been several decisions by the courts which have required railway companies to eliminate mosquito-breeding places along the rights of way when it was proved that the company was responsible for the creation of such breeding places, either by diverting the creek or by borrow pits.

In the opinion of the committee the most important legislation needed at the present time, especially in the Southern States, is with regard to State supervision or impounded waters and providing that the plans and specifications of such projects shall be approved by the State boards of health so far as mosquito breeding is concerned. Under present conditions, except in the few States which have been mentioned, no action, except in an advisory way can be taken until after the area is flooded and then only when it is proved that the public health is seriously affected.

A great many mosquito-breeding places are caused by improper drainage of depressions along highways and railroad rights of way. An effort should be made to persuade all State highway departments and railway companies in those States where mosquito control is being done, to adopt and enforce specifications regarding the proper placing of culverts and draining of borrow pits in order to prevent the creation of new mosquito-breeding places.

REPORTING MALARIA.

All except seven of the States require physicians to report cases of malaria, but it is practically admitted that such reports are far from complete and not indicative of the true prevalence of the disease. In the opinion of your committee it will be many years before the morbidity statistics will be trustworthy. Mortality statistics are of little value in estimating the number of cases in a given district.

As shown in Table I only one of the States estimates that the percentage of reported cases is above 50, three between 25 and 50 per cent and the others less than 10 per cent. This brings up the question as to what method is best suited to determine the amount of malaria in any State. Replies to this question were varied, some stating that it is impossible, with perhaps a slight balance in favor of the census method. Determination by spleen examination was not mentioned, nor does your committee feel that this method lends itself readily to widespread application. A complete malaria census carefully taken, is, in the opinion of your committee, the only practical method which will give results anywhere near the actual truth. In this connection it may be stated that a subcommittee of the National Malaria Committee is at present working for the betterment of malaria morbidity statistics.

TABLE II.

State.	Full-time personnel.		Funds.					
			State.			Other sources.		
	State.	Other sources.	1919	1920	1921	1919	1920	1921
Alabama	1	2	....	$5,000.00	$5,000.00	....	$15,000.00	$15,000.00
Arkansas	....	2	....	....	5,000.00	$29,650.00	33,752.00	....
California	2	....	$15,000.00	....	10,000.00	....	....	....
Connecticut	2	....	3,610.83	6,199.89	4,142.00	....		
Florida	2	....	(1)	....	....	....	....	....
Georgia	....	4	....	6,124.41	....	....	74,783.57	....
Kentucky	1	....	(2)	....	....	....	....	....
Louisiana	....	2	....	500.00	5,000.00	....	14,825.27	....
Mississippi	1	4	....	5,173.00	2,996.00	....	11,868.00	18,432.00
New Mexico	1	....	....	....	2,000.00	....	....	....
North Carolina	....	1	....	?	....	....	24,018.42	....
Rhode Island	....	(3)	....	20,000.00	20,000.00	....	....	....
South Carolina	2	2	....	10,000.00	15,000.00	....	30,500.00	35,000.00
Tennessee	(4)	....	(5)	....	....	....	....	....
Texas	1	3	....	6,000.00	....	....	....	....
Virginia	....	2	....	1,500.00	5,000.00	....	6,250.00	....
New Jersey	2	....	265,000.00	265,000.00	265,000.00	....	....	....

[1] No information, general funds used.
[2] No data available.
[3] Local only.
[4] Work under supervision of United States Public Health Service.
[5] No funds given.

In Table II the personnel from "Other sources" in the majority of instances means the personnel furnished by the Federal Government and International Health Board, and funds from "Other sources" come either from local communities concerned or from the International Health Board.

As to the source of funds, eight States prefer State aid to local communities in addition to supervision. Five prefer total appropriation by local communities with supervision from State; three give this second place and one places it third. One prefers State aid for the first year, the community to assume control, under State supervision, thereafter. One State suggests entire State control of larger problems. Several of the replies are of particular interest and are quoted as follows:

Arkansas.—"Of necessity, all funds for the actual performance of work are provided by the community. It would seem more proper and equitable, however, to have joint appropriations from the Federal, State, and local governments supplemented by voluntary agencies when available."

Connecticut.—"It is believed that in any work of this kind there should be some provision for State aid, particularly for supervision and preliminary surveys, in order to see that it is carried out properly."

Georgia.—"It is believed that the State, where possible, should offer aid to localities to carry on malaria work in addition to supervision, as it is not only a local problem but a State problem; also that the United States Government should offer funds to different States to be distributed in local communities. It is very important to the United States Government in case of war to have its fighting forces fit for service."

Missouri.—"State aid in addition to supervision is thought to be indispensable to get the communities to do much, if any of the mosquito control work in this State, since the value of the work is so little appreciated generally."

South Carolina.—"State aid is given to localities in addition to the supervision, because (*a*) financial condition of towns prohibits work and (*b*) appeal is made on the basis that outside money will be spent if town puts up its share. We can not appeal to people on the grounds of economic loss, as money is too tight."

Tennessee.—"The division of engineering of the State board of health should make surveys and estimates of cost of malaria control operations and should appropriate a part of the money to get the work started and carried on for the first year as an inducement to the localities to institute control measures. After the area has been placed under control, the maintenance costs should be borne by the locality, the only contribution by the State being the services of the engineering division in supervision."

Texas.—"Assistance in financing malaria control operations does not lead to permanent control whether the funds be furnished by State, national, or other sources. All campaigns in Texas are financed solely by the communities during 1921."

TABLE III.—*Showing type of community in which control work has been done during last six years, and division of funds in 1920.*

State.	Municipalities.	Rural communities.	Whole counties.	Division of funds in 1920 (per cent).			
				Population.		Rural.	Special.
				Over 10,000.	1–10.		
Alabama	21			22.5	77.5		
Arkansas	16	9		36.0	61.0		
California	5	10		[1] 33.0		[1] 67.0	
Connecticut	8	4		14.0	43.0	4.0	39.0
Georgia	5	1	2	73.0	9.0	18.0	
Kentucky	1		1				
Louisiana	3				33.0		67.0
Mississippi	18	4	4		100.0		
New Mexico		*				100.0	
North Carolina	7			41.0	59.0		
Pennsylvania	3		1				
Rhode Island	9	2					
South Carolina	3				100.0		
Tennessee	2	2					
Texas	21		1				100.0
Virginia	10	5	2		100.0		

[1] 1919 funds.

Connecticut.—Used 39 per cent of its total appropriation in general supervision of all work.

Texas.—Texas reports as follows: "Funds in 1920 were spent in general education and publicity. Control measures by field engineers were carried out in 13 communities ranging in population from 400 to 7,000, and none in rural districts."

It appears that by far the larger portion of mosquito and malaria control work has been done on a community basis; in fact, 88 per cent of the $211,525 available in 10 of the States in 1920 was spent in community control, and 9 States prefer community control as a basis.

Alabama.—"We confine ourselves to community work, realizing that malaria control is entirely an economic problem. Better rural conditions will come naturally as the land is cleared and drained for cultivation."

Missouri.—"Education along these lines has been so woefully inadequate in the past that an intensive and extensive educational campaign must be carried on with community control to get the full value of the work."

Tennessee.—"Community control is the only feasible method in this State at present, and probably will be for a considerable time to come. Very few county health departments have been developed sufficiently to render them efficient in carrying on rural control as a routine practice. For the present, at least, the best results will be obtained by each community, with the cooperation of the State department of health."

Texas.—"No one method will insure malaria control. While at present practically all control measures are being conducted in urban communities, it is not expected that a continuation of this policy exclusively will obtain the best results. Rural control will consist, however, of drainage and fish control almost exclusively, due to the care and labor required in oiling operations. Rural activities will have to come from spreading of urban demonstrations and not independent operations."

Georgia.—"It is believed that community control is the most important because much more permanent work can be brought about under this head."

Several States in favor of policies other than community control are:

Connecticut.—"A bill was introduced into the present session of the general assembly revising (mosquito) law and placing the entire matter under the director, the expenses to be borne by the State. There are many reasons for this. To begin with, the present law provides for local initiative, with the result that certain towns have ditched all of their salt marsh areas while the adjoining towns would take no action. As the salt marsh mosquitoes migrate for considerable distances, the work already done is not as effective as it should be if all of these towns took similar action. I believe heartily in universal education along these lines, because no matter how well the larger problems will be solved, there will always be the problems of the rain-barrel mosquito on private premises. Then, too, the sooner the people become educated to the importance of such work the sooner can any State put through a scheme for cleaning up its own mosquito-breeding territories."

South Carolina.—"Education decidedly needed. Believe that an extensive educational campaign will give better results than a sporadic control work. Many laymen and some doctors are still skeptical as to the mosquito theory. If the $25,000 available now were spent on advertising, lectures, fair exhibits, etc., I believe an untold amount of good will be obtained. Campaigns would necessitate an experienced, able advertising manager. Work done by the United States Public Health Service, Red Cross, etc., about cantonments has been almost entirely abandoned in South Carolina. Where done or kept up at all it is within city limits and this is not satisfactory as to mosquito control."

In Virginia community control demonstrations have been made for several years past by State aid under the general supervision of the United States Public Health Service and it has been increasingly apparent that the plan is faulty in that the greater problem of rural malaria control has not been attacked. Communities do not always continue work in years following the first demonstration. New communities are loath to take up the work, partly from lack of funds and partly through lack of the realization of the need. At the same time it must be remembered that the control measures in the municipalities have very little effect on the incidence of malaria in the rural districts, nor are the same methods always applicable to both. The work already done in rural districts is entirely different. Past work has demonstrated that the control of malaria and mosquitoes in urban communities is a practical operation when the people and officials will appropriate the necessary funds. In our opinion the next line of attack is in the rural sections.

One county has been selected and a sanitary demonstrator who has been working in it for the past year has been detailed to give his entire time to malaria work during the present summer. He will carry on an intensive educational campaign and visit as many homes as possible to instruct the people as to what they should do for their own protection and also to secure complete records as to cases of malaria and how much time was lost and to make follow-up visits from time to time as may be necessary. In this particular instance, the demonstrator is personally acquainted with and trusted by the people. He thoroughly understands his people and their peculiarity, and tries to show them how to solve their individual mosquito and malaria problems. At the same time he is gathering information which will be of much value in reaching a satisfactory solution of the rural malaria problem. The people have shown such a remarkable interest and spirit of cooperation in this new line of work that the plan will be extended to include several other counties, with a sanitary demonstrator for each, and all under a medical man appointed by the State board to give his full time to malaria study and supervision.

ORGANIZATION.

The answers to a question as to the organization best suited to handle the mosquito and malaria problem show a large preference for the engineering division of the State board of health. Nine give this first choice, two give it second, and two give it third. Three States choose the county and rural health division.

Arkansas.—" Division of malaria control under the bureau of sanitary engineering, with doctor trained in malaria control work as director with a chief sanitary engineer in charge of all work exclusive of medical measures. Where there is a local health organization malaria control should be linked with its program."

Connecticut.—" In Connecticut the organization of antimosquito work has been placed in charge of the director of this agricultural experiment station, though the details of the work are in a large measure supervised by this department, particularly in an advisory capacity. As regards organization, it does not seem to me so very important whether such work is organized under the State board of health or some other agency well suited to carry it on, the members of which are familiar with such problems. In Connecticut the State board of health has acted in an advisory capacity many times, but it has never taken hold of the work in an active manner. Many local health officers have done excellent work in their towns, particularly on the smaller problems and where malarial mosquitoes are breeding. Most of the work in Connecticut has been done through community control, except during the past six years, when State aid has been available. If every community would take up the problem our present system would be adequate and effective."

Florida.—"All malaria control activities are under the engineering division, with a chief sanitary engineer having general supervision."

Georgia.—" I believe that malaria activities should come under the engineering division, as it is almost wholly a question of drainage, followed by other methods which involve a certain amount of engineering supervision. If the work is to be wholly quinine sterilization, it should then come under a separate division of the State board of health, with a doctor in charge. After the work has been conducted by the State board of health or other agencies, it can then be left to the local health officer or county health division to be carried on, the State board of health acting only in an advisory capacity."

Mississippi.—"It is my personal opinion that operations for the prevention and control of malaria should be directed as a part of the activities of the bureau of sanitary engineering, under the general supervision of the State sanitary engineer. By this means all work of sanitation requiring engineering services may be coordinated and given its relative importance. Where work of malaria control is being carried out as a part of the county health unit program, an engineer may be assigned to this particular county at the very inception of the work, with instructions to make a survey and report, including an estimate of cost of the work in the several communities, towns and cities, wherein the work would be feasible, and recommending a general plan of procedure. Copies of this report should be submitted to the State sanitary engineer and the director of the county unit. This report should state not only in what communities the work would be impractical, but with this data in hand the director would be in a position to state clearly to the board of supervisors and other interested parties just what the malaria phase of the work would consist of and could give a definite cost. In this connection the engineer should work under the direct supervision of the director of the health unit, subject, of course, to the call of the State sanitary engineer for preliminary surveys and reports at times when this special work would not conflict with the duties already begun in the unit."

Missouri.—"Malaria control being so largely an engineering question, and the doctors of this State being so generally uninterested in public-health work but more in the practice of medicine, it is thought that this work could be better handled by the engineering division when that is organized."

South Carolina.—"As part of an engineering section under chief engineer, because work, to be permanent, is essentially one of drainage and eradication of mosquitoes. In South Carolina malaria control is main activity for an engineering section and funds can be secured on this project, whereas water and sewage control can not."

Tennessee.—"The work of malaria or mosquito control, being a health problem of more than local interest, should unquestionably come under the jurisdiction of the State board of health, and as it is largely an engineering problem, its direct supervision should be a part of the duties of the division of engineering of that board. The cooperation of the local health organization should be sought, in order to reduce to the minimum the supervision of details by the State engineer."

Texas.—"Malaria control is unquestionably an engineer's problem in the heavily infested areas of this State, and the supervision of this work must be under the direction of one acquainted with an engineer's problems. The work should be preferably directed by an engineer with field experience in order that the situation might be fully appreciated and the most efficient results obtained."

METHODS.

Elimination of the mosquito by drainage operations is the method given preference in 12 States and in 1 place, oiling first.

Connecticut.—"Nearly all of the work in Connecticut has been done by ditching swampy areas and by filling depressions. Some oiling has been done, but this is only a temporary expedient. We have had some experience in building dikes and tide gates, these being incidental to the general problem, especially on salt marshes."

CONTROL METHODS.

No new methods were brought out in the replies to the questionnaire. Those used in the various States have for the most part been published by the Public Health Service or in the reports and bulletins issued by the various State boards.

CONCLUSIONS.

Your committee has attempted to present in this report merely a summary concerning the progress of mosquito control and opinions from different States with regard to organization, expenditure of funds, and legislation with the hope that the discussions may bring out facts which will be helpful to the members of the association. Malaria control is yet in its infancy and much remains to be done before conclusions can be reached as to the best policies and methods applicable to the country as a whole or any group of States in which conditions are similar. One fact, however, must not be lost sight of, the public does not yet appreciate that there are practical methods by which mosquitoes can be controlled with a reasonable expenditure of funds. Hence publicity and education should be carried on more vigorously than ever. We believe that Dr. T. H. D. Griffitts has the right point of view when he says:

> I feel that I have done my best day's work in malaria prevention after having talked to public-school teachers and students of the essentials of the cause and prevention of malaria. If the public thinks—and thinks rightly—they will act rightly, and results will make a bold showing 10 years from now.

A motion was made, seconded, and approved to adopt this report.

Mr. Gage presented the following report:

REPORT OF COMMITTEE ON SWIMMING POOLS.

For the past two years, a committee of the sanitary engineering section of the American Public Health Association has been engaged in a study of various phases relating to the sanitation of swimming pools and other bathing places. As the work of your committee must necessarily cover the same field as that of the American Public Health Association committee, it has seemed to us that useless duplication of effort could be avoided and more real progress made by coordinating work of these two committees, and this coordination has readily been accomplished through the fact that all members of your committee are also members of the American Public Health Association committee.

In this report, we wish to emphasize certain facts obtained by the American Public Health Association committee, to briefly review certain rules which have been promulgated for the regulation of swimming pools, and to submit for criticism and suggestion certain tentative rules, the observance of which we believe might prevent undue pollution of swimming-pool waters.

In 1920, the American Public Health Association committee requested the sanitary engineers of the various States to assist in the collection of statistics of swimming pools in territory under their jurisdiction. In response to this request, information regarding 506 pools was obtained from 18 States. Data relating to 42 pools in 7 other States was obtained from outside sources. The Public Health authorities of 30 of the 48 States were unable to supply the committee with information even as to the number and location of pools within their territory.

It seems strangely inconsistent that although the publicity organs of many State and city health departments have from time to time emphasized the hygienic importance of bathing, very few such departments have taken the pains to inform themselves as to the sanitary conditions, or, should we say, lack of sanitary conditions, which prevail at their various public bathing places.

It is generally recognized that certain diseases may be transmitted through contamination of swimming-pool water. To properly safeguard against the carriage of infection in this manner, swimming pools should either be emptied and refilled frequently or the entire body of water should be disinfected at regular and frequent intervals.

Refiltration without disinfection can not usually be relied upon to completely remove bacterial contamination.

A study of the statistics obtained by the American Public Health Association committee for 548 pools reveals the fact that in about one-third of these pools the water was allowed to remain three days or longer without any attempt at disinfection. At 7 pools, where no disinfectant was employed, the water was changed only once or twice a year and at 6 others the water remained in the pool two months or longer. In one instance, it was stated that the water was never changed or disinfected and that filters for clarifying the water had not been provided. Surely these are conditions well worthy of consideration by public health officials.

The various factors entering into the problem are so many and so varied and are so closely interrelated in their influence upon health and sanitation, that their full significance can only be appreciated and understood by a trained sanitary engineer.

For financial reasons, it is impossible for the usual Y. M. C. A., school or club to employ trained sanitarians to operate their swimming pools. Judging from the experience of the members of your committee, however, the managers of practically all such pools would be only too glad to cooperate with some central authority, such as the State health department, in order to improve the sanitary conditions at their various establishments.

In two States, California and Florida, sanitation of swimming pools is under the control of the State department of health by statutory provision. The State departments of health of West Virginia and Virginia have also passed regulations for the control of swimming pools under statutes authorizing them to formulate a sanitary code. The regulations adopted by these four States for the sanitary control of swimming pools are similar in character and embody the following features:

1. The bacterial contamination of the water in the pool must be maintained at a practicable minimum.
2. The water in the pool shall at all times of use be sufficiently transparent to enable a person standing at the side of the pool to distinctly see the bottom at a depth of 6 feet.
3. Facilities must be provided for adequately protecting the water against sputum contamination by bathers.
4. All persons known or suspected of being afflicted with any infectious diseases must be excluded from the pool.
5. Provision must be made to insure the personal cleanliness of bathers entering the pool.
6. Construction of the pool must be such as to reduce danger of injury from falls and collisions to a minimum.

7. Every reasonable precaution must be taken to prevent drowning accidents.

8. Dressing rooms, toilet rooms, shower baths, and other places to which patrons have access must be clean and well ventilated at all times.

9. Bathing suits and towels furnished by the pool management must be clean and free from bacterial contamination.

10. Rules which must be observed by patrons for the maintenance of a safe and sanitary pool must be posted in conspicuous places about the establishment.

Your committee feel that these are the minimum requirements for the maintenance of a safe and sanitary swimming pool.

In the California regulations the bacterial content of the water in a swimming pool has been tentatively limited to 1,000 bacteria per cubic centimeter determined on standard agar incubated 24 hours at body temperature, and the presence of fermenting bacteria to not more than one-half of the 1 cubic centimeter gas test.

In the Florida regulations a limit has been placed on the number of bathers who may be permitted to use a fill and draw pool.

In each of these States it is required that careful operation records and statistics of the use of the pool be kept by the management for the benefit of the State health officials.

It is well recognized that the amount of dirt and dangerous contamination introduced into any swimming pool is dependent upon the relation between the volume of water, the number of bathers, and the frequency with which the water is either changed or purified and disinfected. It has occurred to us, therefore, that the reasonable cleanliness and freedom from contamination of the water in any swimming pool might be assured by limiting the number of bathers permitted to use that pool in a given time.

Some years ago Gage proposed the term "bathing load" to express the relation between the volume of a pool and the number of bathers using it during any stated time. More recently Fair has proposed two other terms to indicate, respectively, the relative danger of transmission of disease and the probable dirtiness of the water in different pools. One of these terms, "the index of contamination," expresses the relation between the number of bathers, the volume of water in the pool, and the effective measures taken to remove or destroy bacterial contamination. The other term, "the index of stagnation," expresses the relation between the number of bathers, the volume of water, and the measures taken to remove dirt from the water.

For the purpose of determining the reasonable usage of a swimming pool, the committee has made a study of the bathing load, index of stagnation, and the index of contamination in their relation to the chemical and bacterial quality of the water in a number of pools where all factors which might influence pollution and contamination are accurately known.

As a result of these studies we offer for further study and criticism the following rules limiting the bathing load upon swimming pools:

1. The total number of bathers using a swimming pool during any period of time shall not exceed 20 persons for each thousand gallons of clean water added to the pool during that period. The term clean water as used above may be interpreted to mean, new, clean water used to refill the pool, new, clean water used to replace loss by splashing or during cleaning, water taken from the pool and returned after effective filtration, or any combination of such waters.
2. The total number of bathers permitted to use a swimming pool during any period of time shall not exceed seven persons for each thousand gallons of water in the pool unless the pool shall have been completely disinfected at least once during that period by means approved by the State department of health.

In conclusion your committee would suggest that its work be continued another year and that the coordination of this work with that of the committee on bathing places of the sanitary engineering section of the American Public Health Association be approved.

A motion was made, seconded, and approved to adopt this report.

Mr. Theodore Horton submitted the following report:

CONSTITUTION OF THE CONFERENCE OF STATE SANITARY ENGINEERS.

Article I.

This conference shall be called the Conference of State Sanitary Engineers.

Article II.

The object of this conference is to coordinate the public health engineering activities of the official State health organizations and to encourage the interchange of experiences among sanitary engineers in official administrative positions.

Article III.

Membership shall consist of representatives from each State government and from the United States Government. The representatives of each State government may include the chief sanitary engineer of the State health department and other chief sanitary engineering officials having charge of sanitary engineering work of the States. The representatives of the United States Government may include sanitary engineers of the United States Public Health Service, not to exceed three in number, engaged upon sanitary engineering work. Eligibility shall be determined by the executive committee. Any member may delegate one of his assistants to represent him at any conference.

ARTICLE IV.

Each State shall be entitled to one vote, and the United States Public Health Service shall be entitled to one vote. A majority vote shall be necessary to decide all questions which come before the conference.

ARTICLE V.

The officers shall be a chairman, vice chairman, secretary-treasurer, and corresponding secretary.

All officers shall be selected by ballot biannually, except the corresponding secretary, which position shall be filled by the Public Health Service sanitary engineer detailed at the bureau in Washington. Officers so elected shall not take office until the expiration of the conference at which they are elected.

ARTICLE VI.

The chairman, vice chairman, secretary-treasurer, and two other members, who shall be elected at the regular meeting of the conference, shall form the executive committee to carry out the work of the conference between meetings. Other committees shall be appointed by the conference or by the executive committee, as is found desirable.

ARTICLE VII.

The secretary-treasurer shall also be secretary of the executive committee and shall perform such duties as may be found necessary.

The corresponding secretary shall collect, analyze, and report to all State sanitary engineering divisions, data on the prevailing and proposed activities in sanitary engineering of probable interest to them, and shall perform such other duties as the executive committee may require of him.

ARTICLE VIII.

The time and place of the next meeting may be fixed at any session of the conference, or may be made subject to the call of the executive committee, providing chief sanitary engineers of at least 10 States signify their intention of attending such meeting.

ARTICLE IX.

Amendments to the constitution shall be voted on at sessions of the conference, and, if approved, shall then be presented by letter to all members of the conference for vote, an affirmative vote of two-thirds of the members of the conference being required for adoption.

It was moved, seconded, and passed that the proceedings of the meeting be printed and distributed to all the members of the conference.

The conference elected the following officers: Mr. Emerson, Pennsylvania, chairman; Mr. Dittoe, Ohio, vice chairman; Mr. Horton, New York, secretary.

The executive committee chosen consisted of Mr. Emerson, chairman; Mr. Dittoe, Mr. Horton, Mr. Whittaker, and Mr. Simons. Mr. Mendelsohn was retained as corresponding secretary.

Mr. Emerson delivered an address outlining plans for the next conference meeting and the work in the meantime.

A discussion was held on the program for the next meeting of the conference, it being decided that a letter should be sent each State sanitary engineer six months before the meeting requesting suggestions regarding the program. A program consisting of a series of limited discussions on topics chosen by the members was found most satisfactory.

A discussion was held on practices of engineering firms engaged in sanitary engineering construction work, also on the regulation of mausoleums by State health departments.

The conference then adjourned.

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